**IN THE UNITED STATES DISTRICT COURT**
**FOR THE NORTHERN DISTRICT OF CALIFORNIA**
**SAN FRANCISCO DIVISION**

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| ORACLE AMERICA, INC.<br><br>Plaintiff,<br><br>v.<br><br>GOOGLE, INC.<br><br>Defendant. | ) | Case No. CV-03561-WHA |

# EXPERT REPORT OF PROFESSOR JAMES R. KEARL

**(CORRECTED March 21, 2016)**

March 18, 2016

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## 1. Qualifications

1. I am currently the A.O. Smoot Professor of Economics at Brigham Young University (BYU) and a Senior Consultant with Charles River Associates, a firm that provides expert analysis, litigation support, and business consulting in sophisticated matters involving economics and finance. I received my Ph.D. in Economics from the Massachusetts Institute of Technology in 1975 and completed postdoctoral studies in law and economics at the Harvard Law School in 1979. I have been a member of the Economics Department at BYU since 1975. Prior to that time I was a teaching fellow at Harvard University. From 1978 to 1983, I held a joint appointment in the Economics Department and J. Reuben Clark Law School at BYU. Over the past 30 years, I have taught courses in the Principles of Economics, Microeconomic Theory, Applied Microeconomics, Industrial Organization, Economics of Antitrust and Regulation, Applied Welfare Economics, International Trade, International Trade Policy, and Law and Economics. I have also team taught courses at BYU's J. Reuben Clark Law School in Antitrust Law, Regulatory and Administrative Law, and International Trade Law and Regulation. In addition, I have lectured for the U.S. Government in a number of countries on the Economics of U.S. Trade Policy, Law and Economics, and the Economics of U.S. Antitrust Laws. I have also taught courses on the same topics at the Republic of China's Professional Training Center and at its Land Development Institute. My curriculum vita is attached to this report as Appendix A. A list of testimony provided during the past four years is attached to this report as Appendix B. My hourly billing rate for this assignment is $780 per hour.

## 2. Assignment

2. I was initially retained by the Court, per Judge William Alsup's order of September 9, 2011, to a) independently critique the damages reports submitted by each party, b) provide my assessment of any or all issues raised or presented in the damages reports of the parties,

and c) address each additional issue I believe should be evaluated in order to provide the jury with a complete and independent view of damages in this case.[1] I filed an expert report in the previous phase of this litigation and was deposed.[2] That report and deposition addressed, among other topics, the copyright damages that are currently at issue.

3. By an order dated December 9, 2015, the Court clarified my assignment, with the purpose of my appointment as a Rule 706 expert to provide an independent and professional analysis and view to inform and clarify the issue of damages for the jury.[3]

4. In carrying out my assignment, I have reviewed the expert reports of all experts filed in this phase of the litigation, but have focused my attention on the reports of Mr. Malackowski, Dr. Leonard, and Professor Jaffe.[4]

5. I assume for purposes of my analyses that Google has been found to have infringed the in-suit copyrights and that this infringement is not a Fair Use. I have no expertise in the law, in the engineering and technical aspects of the copyrights at issue in this case, or in resolving factual disputes. As such, I have tried to be very careful with regard to differences between Mr. Malackowski, Dr. Leonard, and Professor Jaffe that may turn on technical or factual disputes where economic principles or analysis provide little or no insight and have tried, in so far as possible, to focus on those areas where economic analysis provides assistance to the Court. In instances where disputed factual or legal matters have a large

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[1] Order Re Rule 706 Expert, dated September 9, 2011.

[2] Expert Report of Professor James R. Kearl, Revised March 28, 2012; Deposition of Professor James R. Kearl, March 26, 2012.

[3] Order Clarifying the Assignment of Rule 706 Expert, Document 1395, filed December 9, 2015.

[4] Expert Report of James E. Malackowski, January 8, 2016 (Corrected); Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected); Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016; Rebuttal Expert Report of Dr. Gregory K. Leonard, February 29, 2016; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected); Reply Expert Report of Professor Adam Jaffe, Ph.D., February 29, 2016.

impact on the damages analysis, I have endeavored to provide alternative damages estimates based on alternative assumptions about the governing law or the findings of fact.

## 3. Materials Relied Upon

6. Typically, an expert witness works closely with the counsel for the party who retained him. This is helpful because an expert can rely on the party's counsel to provide evidence, either supportive or not, from the record relevant to his opinions. Since I was retained by the Court and not by Google or Oracle, my ability to access the voluminous record in this case is more limited. I have assumed that because of the adversarial nature of litigation, however, all of the material in this voluminous record directly relevant to damages is contained in the experts' original, rebuttal and reply reports, revisions of reports, deposition testimony, and deposition exhibits. Hence, the universe of discovery materials with which I've worked is the documents, deposition testimony and evidence cited in the technical and damages expert reports filed in this matter, backup materials for the analyses incorporated in these reports including data collected by the experts, exhibits introduced at the depositions of experts, and the deposition testimony of the experts. I have also relied on data, computer code, and Excel worksheets provided by Mr. Malackowski and Dr. Leonard.

7. I have also conducted independent research into some economic issues that are relevant to the issues in-suit. Appendix C lists the materials available to me from the parties, as well as the materials I have independently gathered. I have cited to materials specifically relied upon in the footnotes of this report.

## 4. Summary of Opinions

8. Consideration of non-infringing alternatives in a disgorgement analysis makes economic sense, either explicitly or as a basis for apportionment.

9. If the next best non-infringing alternative for Google was not to pursue Android at all, disgorgement damages would total approximately $7.7 billion.

10. If the next best non-infringing alternative to Google was to develop a non-infringing Android, and the market success of this product would have equaled the market success of the actual (infringing) Android, disgorgement damages would total approximately $0.

11. If the next best non-infringing alternative to Google was to develop a non-infringing Android, and the market success of this product would have been less than the market success of the actual (infringing) Android, disgorgement damages would depend on the difference in market success. I present alternative disgorgement damages estimates for various assumed market share reductions of Android between $2.08 billion and $3.51 billion.

12. There isn't good economic evidence in the record or from either side's experts on what would be the market success of a non-infringing Android. The experts in this phase, and in the earlier phase of this litigation, have focused almost exclusively on the availability within a fairly short period of time of a large number of apps. Dr. Leonard's analysis – based on the Kim model – which focuses on a relatively small number of top apps is useful, but in a limited way as discussed herein. Mr. Malackowski and Dr. Jaffe do not offer an estimate of the reduced market share of Android (other than to assume explicitly or implicitly that this share would be 0%).

13. Present value of lost Java ME profits due to the copyright infringement total approximately $87 million.

## 5. Foundational Issues

14. Oracle asserts that the Google Android operating system infringes certain Oracle copyrights. While there are other copyrights at issue, I focus my attention on the 37 API copyrights that Oracle alleges to be infringed by Android (hereafter "37 Java APIs").

15. I understand that a copyright owner alleging infringement can claim as damages its actual losses, as well as (to the extent not taken into account in an award for actual losses) the infringer's wrongful profits. In this matter, Oracle claims damages based on the infringer's wrongful profits (so called "disgorgement") and actual losses related to decreased demand for its Java ME product.

16. In responding to Mr. Malackowski's opinions regarding disgorgement damages, Dr. Leonard relies in part on analyses of the next-best non-infringing alternatives available to Google, and the profits Google would have made under those alternatives.[5] Mr. Malackowski argues that consideration of non-infringing alternatives is improper when calculating disgorgement damages and cites to an order from the Court stating that non-infringing alternatives have nothing to do with disgorgement.[6] However, Mr. Malackowski apparently does believe that the wrongful profits subject to disgorgement need to be apportioned based on the "relative value" of the copyrighted material to the overall work.[7]

17. As discussed below, there does not appear to be a clear distinction between considering non-infringing alternatives and apportioning wrongful profits based on relative value of the copyrighted material to the overall work. Thus, I present analysis of disgorgement damages below based on the various non-infringing alternatives posited by Dr. Leonard.[8] Obviously,

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[5] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 174-196.

[6] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 14 and 30-37. Mr. Malackowski also uses the term "counterfactuals" to denote the consideration of non-infringing alternatives.

[7] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 269.

[8] Oracle's other economic expert, Professor Jaffe, appears to agree with me, as stated in his (corrected) February 8, 2016 report, para. 440: "As an economist, I think about the decisions companies make in light of the alternatives they are considering."

should the Court instruct that this approach is legally impermissible, then I would remove this portion of the report.[9]

## 6. Treatment of Technical Issues

18. Speaking broadly, Oracle asserts that the infringement of the 37 Java APIs led to a large increase in the number of applications available on the Android platform, and that this increase in the number of available apps was critical (indeed, essential) to the success of Android.[10] Google asserts that the use of the 37 Java APIs did not materially increase the number of apps available for Android, and that any increase in the number of available apps was not material in the market acceptance of Android.[11] While an economist does bring expertise to the question of whether greater app availability is important to the market acceptance of smartphone platforms, economists do not have unique expertise in the question of whether the use of the 37 Java APIs led to an increased number of available apps for Android.

19. There appears to be good evidence that consumers and Original Equipment Manufacturers ("OEMs"), as well as Google, placed value on the number of applications available on the

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[9] In the initial phase of this case, I had the advantage that the Court had ruled on Daubert and like motions before I submitted my report, which narrowed my opinions to matters still before the Court. Because of the accelerated schedule in this phase, my report will be submitted before Daubert and like challenges and it may be that matters in other expert reports on which I opine in this report will be excluded by the Court. In such cases, I would expect that sections or paragraphs that correspond to specific exclusions will be dropped from this version of my report.

[10] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 162: "Android would need hundreds of thousands of apps available to be attractive to developers and consumers."

[11] Oracle also asserts that use of the 37 Java APIs enabled Google to bring Android to the market faster than would have been otherwise possible. Google and Dr. Leonard dispute this and Dr. Leonard, in particular, appears to be of the opinion that Google could have based Android on a different programming language (C++ for example) with little, if any, effect on when Android became available. This is essentially a factual dispute, but neither Mr. Malackowski nor Dr. Leonard estimate damages assuming that Android would have been delayed But-For the use of the 37 Java APIs.

Android platform.[12] Thus, as a general matter, if the jury finds that the use of the 37 Java APIs allowed Android to have a greater number of applications than it otherwise would have had, I would advise the jury that these copyrights have a high value. Conversely, if the jury finds that, absent infringement, Android would have almost as many applications (because, for example, the 37 Java APIs do not lead to a significantly larger number of apps), then I would advise the jury that the value of these copyrights is relatively small. Below I present damages estimates based on both the assumption that the 37 Java APIs allowed a sufficiently larger number of Android apps such that the use of the 37 Java APIs was essential to the success of Android, and various assumptions that the use of the copyrighted APIs allowed only a small, or no, increase in the number of available apps on Android and was not essential to the success of Android.

## 7. Background

20. The Google business model is described in the reports of Mr. Malackowski, Dr. Leonard, and Professor Jaffe. Generally, while Google is a large company with many products and services, an important part of that business is online advertising.[13] Google can realize advertising revenue when ads are displayed on pages showing Google search results, when Google-placed ads are displayed on the websites of Google Network members, and when

[12] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 148; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 103-104, 204, 213, 240 and 242. See also my previous report, Expert Report of Professor James R. Kearl, Revised March 28, 2012, fn. 104 listing industry sources for the value consumers place on the number of apps available.

[13] Google Inc. and Alphabet Inc. Form 10-K for the fiscal year ended December 31, 2015, p. 2: "We generate revenues primarily by delivering online advertising that consumers find relevant and that advertisers find cost-effective." Google Inc. Form 10-K for the fiscal year ended December 31, 2014, p. 48: "We generate revenues primarily by delivering relevant, cost-effective online advertising." Google Inc. Form 10-K for the fiscal year ended December 31, 2013, p.3: "We generate revenues primarily by delivering online advertising that consumers find relevant and that advertisers find cost-effective." Google Inc. Form 10-K for the fiscal year ended December 31, 2012, p. 30: "We generate revenue primarily by delivering relevant, cost-effective online advertising."

Google-placed ads are displayed in apps.[14] Google advertising is not limited to advertising on Android devices. Google also receives ad revenue from ads displayed on other, non-Android-based, mobile devices such as Apple iPhones, and from ads displayed on web-sites and search results that are viewed, for instance, on a desktop or laptop computer.[15]

21. Google also makes Android-related money in other ways. Most notably, Google sells mobile device hardware (the Nexus line of phones and tablets) that operate on the Android platform, and Google also operates the Google Play store on which it sells digital content such as movies, music and apps.[16]

22. Some of the revenue that Google receives from its advertising is shared with its business partners. For instance, Google may share ad revenue from ads viewed on a Dell laptop computer with Dell in exchange for Dell making Google the default search engine on that laptop.[17] For ads viewed on mobile devices, Google may share ad revenue with the maker of the mobile device (e.g., Apple or Microsoft or Samsung, so called "OEMs") and also with the telecommunications carrier on whose network the mobile device is connected (e.g.,

[14] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 15-17; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 104; Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 265-270.

[15] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 15-17 and 62-63; Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 265; Google Inc. Form 10-K for the fiscal year ended December 31, 2014, p. 22.

[16] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 245-261; Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 15 and 26-28; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 221 and 237-246.

[17] Google Inc. Form 10-K for the fiscal year ended December 31, 2012, p. 35; Google Inc. Form 10-K for the fiscal year ended December 31, 2013, p. 30; Google Inc. Form 10-K for the fiscal year ended December 31, 2014, p. 49.

AT&T or Verizon, so called "carriers").[18] These revenue sharing payments by Google are generally called Traffic Acquisition Costs ("TACs").[19]

23. While Google realizes a large amount of revenue from advertising displayed on Android devices, Google does not sell Android itself.[20] Google makes Android available at no cost to OEMs for use on the OEMs' products. The development and market success of Android was important to Google because (among other possible reasons) the success of Android prevented other mobile device platform operators (such as Apple and Microsoft) from directing web traffic on their devices away from Google and thereby being "locked out" of the increasingly large mobile search and advertising business or using the threat to do so in order to negotiate a higher TAC (i.e., a higher share of the Google ad revenue for ads displayed on the other platform's devices).[21] One measure of the value of Android to Google is that it allows Google to pay lower TAC costs (and therefore keep a larger share of its ad revenue) for ads displayed on an Android device than what Google pays Apple or Microsoft or other non-Android platform device developers for ads displayed on an iPhone or Windows Mobile phone or other non-Android device.[22] Thus in some sense, Android

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[18] Google Inc. Form 10-K for the fiscal year ended December 31, 2013, p. 31; Google Inc. Form 10-K for the fiscal year ended December 31, 2014, pp. 26-27.

[19] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 297; Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 32; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 90.

[20] Google Inc. Form 10-K for the fiscal year ended December 31, 2013, p. 5: "…we developed Android, a free, fully open source mobile software platform that any developer can use…". See also Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 14; Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 205.

[21] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 114 and 125; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 210-211.

[22] See, for example, Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 68: "Google developed and commercialized the Android operating system to, among other things, avoid paying TAC to other mobile platforms to direct Internet traffic to Google websites."

does not generate ad revenue for Google (as I understand the matter, Google gets the same payment from the advertiser whether its ad is viewed on an Android phone or an iPhone), but instead lowers Google's cost of displaying ads.[23]

24. As discussed above, I understand that Google pays TAC through ad revenue-sharing agreements to carriers and OEMs. I also understand that these ad revenue-sharing rates may vary depending on the platform (Android vs. Non-Android),[24] Search Method (Default Browser vs. Google.com),[25] ad type (Search vs. AdSense or Display),[26] by agreement

[23] Thinking of Android as a cost-saving, rather than revenue-increasing, product also brings clarity to the causal nexus issue. I understand that in order to recover disgorgement, the plaintiff has to show a causal nexus between the profits it seeks to recover, and the infringement (See, for instance, Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 219 and 220.). Both the Oracle and Google experts focus their causal nexus arguments on the impact of Android on Google revenues. However, profits are a function of both revenues and of costs, and the primary method by which Android increases Google profits (especially its search ad profits) is by lowering Google's Traffic Acquisition Costs on these revenues. Thus, the relevant question would seem to be not whether Android search ad revenues have a causal nexus to Android, but whether the lower TAC that Google pays on Android search ad revenue has a causal nexus to Android. If the question is posed this way, it seems clear that this cost savings is causally related to Android. (Whether a causal nexus to the 37 Java API's exists, however, is less clear.)

[24] See, for example, Case No. CV 10-03561 WHA, Response to Docket No. 1436, "Google Search Distribution Agreements with Non-Android Mobile Operating System Partners"; Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 68: "Google developed and commercialized the Android operating system to, among other things, avoid paying TAC to other mobile platforms to direct Internet traffic to Google websites"; GOOG-00130338 at 343-344; Deposition of Jonathan Gold, December 11, 2015, pp. 188-189, 14-15.

[25] See, for example, Deposition of Jonathan Gold, December 11, 2015, pp. 150-151; Deposition of Aditya K. Agarwal, April 8, 2011, pp. 76-77.

[26] See, for example, Deposition of Jonathan Gold, December 11, 2015, pp. 148-154; Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1d; Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibits 7.2, 7.3, 7.4, 7.5; Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 15-17, 62-63; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 104; Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 265-270. See also Exhibit 1.

(Google negotiates specific agreements with individual Carriers and OEMs),[27] and over time.[28] In addition, Google also has revenue-sharing agreements related to the sale of applications on the Android Market or Google Play store with developers, carriers, and OEMs.[29] These are not equivalent to Traffic Acquisition Costs, which are costs associated with advertising rather than the sale of apps or music. I understand that, in general, Google's Traffic Acquisition Costs, specifically those related to search, are lower on Android than on Non-Android platforms. In fact, this appears to have been one of the key motivations of Google's development of the Android platform.[30]

25. A clear understanding of Google's TAC payments is very important in calculating damages in this case. However, there appears to be a general lack of clarity with regard to sources of TAC and of data specific to the type and amount of TAC paid to OEMs, carriers and others (if any). The various experts in this litigation have differing understandings as to how much TAC Google paid, to whom Google paid it, and how these payments were reported. For example, it remains unclear whether Google pays TAC on Android devices to either OEMs or carriers or to both.

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[27] See, for example, Deposition of Jonathan Gold, December 11, 2015, pp. 24, 152, 155, 190-191, 196-197; Deposition of Aditya K. Agarwal, April 8, 2011, pp. 108-109, 111; Expert Report of Dr. Iain M. Cockburn, February 3, 2012, para. 573; Case No. CV 10-03561 WHA, Response to Docket No. 1436, "Google Search Distribution Agreements with Non-Android Mobile Operating System Partners".

[28] See, for example, Deposition of Jonathan Gold, December 11, 2015, pp. 152, 155, 190-191, 196-197.

[29] Deposition of Jonathan Gold, December 11, 2015, pp. 185-186; Deposition of Aditya K. Agarwal, April 8, 2011, pp. 56-58. Note that Mr. Agarwal appears to indicate that Google shares app sale revenue with either the carrier or the OEM, but not both.

[30] See, for example, Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 68; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 261.

26. Dr. Cockburn understood that Android was made free to OEMs and that Google "appears to have eliminated revenue sharing even to the very same OEMs which it pays for distribution in non-Android devices".[31] Thus, Professor Cockburn appears to say that the TAC for Android OEMs is 0%. Mr. Malackowski appears to understand that Google used revenue-sharing agreements with Android OEMs, as well as carriers.[32] In fact, Mr. Malackowski contends that OEMs were "paid off" through "large market distribution payments" rather than Android being "free of charge".[33] Thus, Mr. Malackowski believes Android OEM TAC is greater than 0%. Similarly, Dr. Jaffe appears to understand that Google pays Android revenue-share with both Android OEMs and carriers[34] and that "Android's offering to device manufacturers and other business partners is often even more attractive than 'free,' as it comes with a revenue sharing subsidy".[35] Dr. Leonard also appears to understand that Google either pays or has paid Traffic Acquisition Costs to Android OEMs, in addition to carriers.[36] However, no one appears to know what TAC Google pays specific OEMs, how this varies by the mobile operating system, how it has varied over time, and whether the TAC that Google pays carriers depends on the OEM or operating system of the phone.

27. There is also disagreement between Mr. Malackowski and Dr. Leonard over how Android Search Ad Traffic Acquisition Costs should be estimated after 2010. Beginning in 2011,

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[31] Expert Report of Dr. Iain M. Cockburn, February 3, 2012, para. 572; Google, "Android Strategy and Partnership Overview," June 2009, GOOGLE-22-00060007 at 029.

[32] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 134, 152-159, 212; Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 69; Deposition of James E. Malackowski, March 16, 2016, pp. 307-308, 315-316.

[33] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 212.

[34] Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 24, 299.

[35] Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 299.

[36] Deposition of Dr. Gregory K. Leonard, March 11, 2016, pp. 338-340.

Google stopped tracking Android-specific Traffic Acquisition Costs.[37] As such, Mr. Malackowski and Dr. Leonard have put forth various ways of estimating Android-specific Traffic Acquisition Costs.[38] While there is currently agreement between Mr. Malackowski and Dr. Leonard on how to estimate Android-specific AdSense and Display TAC, there is disagreement over the estimation of Android Search ad TAC. Mr. Malackowski claims that Android Search TAC for 2011 onward is recorded in the "Apps" and "Digital Content" cost line items in the Android P&L materials.[39] He bases this on certain excerpts from Jonathan Gold's December 11, 2015 Deposition.[40] Dr. Leonard, on the other hand, estimates Android Search TAC using Google's overall AdWords TAC to Revenue ratio.[41] Thus, because Dr. Leonard includes both the cost line items for "Apps" and "Digital Content" and an estimation of Android Search TAC, Mr. Malackowski claims that Dr. Leonard is double-counting Android Search TAC. When questioned about this issue in his March 11, 2016 deposition, Dr. Leonard answered that Mr. Malackowski was incorrect and that these "Apps" and "Digital Content" costs reflect the costs associated with the purchasing of apps and digital content, rather than advertising.[42] In addition, Dr. Leonard claimed that he has had conversations with Google about this issue and their explanations were "inconsistent" with Mr.

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[37] Deposition of Jonathan Gold, December 11, 2015, p. 64:13-23; Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 24; Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 299.

[38] See also Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 297-300; Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 65-72, Revised Exhibit 7 and Exhibit 7.1; Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 32-33; and Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1d.

[39] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 65-72, Revised Exhibit 7; Deposition of James E. Malackowski, March 16, 2016, pp. 162-184.

[40] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 70; Deposition of Jonathan Gold, December 11, 2015, pp. 185-186.

[41] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1d.

[42] Deposition of Dr. Gregory K. Leonard, March 11, 2016, pp. 214-215.

Malackowski's approach.[43] In his deposition, Mr. Malackowski reiterated his belief that he has correctly and fully accounted for Android Search Ad TAC.[44]

28. Upon reviewing available materials, including the deposition of Jonathan Gold that Mr. Malackowski cites, it would appear that Mr. Malackowski may have been mistaken.[45] As this is a fact issue, I will defer to the Court and jury to decide. For the purposes of my analyses in this report, however, I will use Dr. Leonard's approach. Should the jury decide that Mr. Malackowski is correct that Android Search Ad Traffic Acquisition Costs are recorded in the "Apps" and "Digital Content" cost line items of the Android P&Ls, I will adjust my analysis to reflect this.

29. Exhibit 1 provides a comparison of Dr. Leonard's and Mr. Malackowski's TAC estimation approaches. As this exhibit illustrates, the difference between Dr. Leonard and Mr. Malackowski, which is almost solely due to this factual dispute about where Android Search Ad TAC are booked, will substantially affect the estimate of Android profits.

30. In early 2016, Google produced a document titled "Google Search Distribution Agreements with Non-Android Mobile Operating System Partners".[46] This document reports Search ad

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[43] Deposition of Dr. Gregory K. Leonard, March 11, 2016, pp. 214-215.

[44] Deposition of James E. Malackowski, March 16, 2016, pp. 162-184.

[45] Deposition of Jonathan Gold, December 11, 2015, pp. 185-186. Note that Mr. Gold is answering questions based on the May 2015, "Introduction to Android" presentation (GOOG-00130338) rather than the Android P&Ls. The specific statement referenced in the question appears to be speaking of all Android Traffic Acquisition Costs in general: "In 2015, we expect to pay [redacted] to our Carrier, OEM, and Retail partners through rev-share agreements, channel incentives, and rent" (GOOG-00130338 at 340; Deposition of Jonathan Gold, December 11, 2015, p. 185). Earlier in his deposition, Mr. Gold answers questions about the Android P&Ls. He appears to state that Distribution Partner TAC is not included in the "Apps" and "Digital Cost" line items of the Android P&Ls (Deposition of Jonathan Gold, December 11, 2015, pp. 71-72) and, relatedly, that TAC for Distribution Partners is included in the general Google AdWords TAC, which Dr. Leonard uses in his approximation of Android Search TAC (Deposition of Jonathan Gold, December 11, 2015, pp. 149-150; Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1d).

[46] Case No. CV 10-03561 WHA, Response to Docket No. 1436, "Google Search Distribution Agreements with Non-Android Mobile Operating System Partners".

revenue-sharing (TAC) rates for these partners by year. Mr. Malackowski analyzed this document and calculated a weighted average Search ad TAC rate [redacted][47] Excluding Partner "A", the weighted average Search ad TAC rate [redacted][48] This document does not show the TAC that Google pays Android OEMs.

31. Google also apparently pays TAC to carriers.[49] At paragraphs 152 to 159 of his first report, Mr. Malackowski discusses some of the agreements Google has with carriers. At least some of these agreements appear to have Search ad revenue sharing provisions, with the carrier share ranging from approximately [redacted][50] Mr. Malackowski does not discuss whether these carrier revenue shares depend on the type of phone or phone platform on which an ad is viewed on.

32. As described above, while I acknowledge the lack of clarity with respect to the details of Google's TAC payments, I understand that Google has, in general [redacted]. There appears to be general consensus in this matter. In particular, a May 2015 Google presentation, "Introduction to Android", reports that TAC on Android devices is approximately [redacted] while TAC on Apple's iOS is approximately [redacted] a difference of [redacted].[51] This presentation also appears to show that while Android TAC costs are [redacted] for Search ads, they are [redacted]

[47] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibit 7.6.

[48] Calculated using Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibit 7.6.

[49] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 68; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 262.

[50] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), paras. 152-159.

[51] GOOG-00130338 at 343-344; See also Deposition of Jonathan Gold, December 11, 2015, pp. 188-189, 14-15.

[redacted] for Display ads. That is, Android has [redacted] Search ad revenue on [redacted], but this does not appear to be true for AdSense or Display ads, which reside on third-party websites or applications.

33. I assume for my analysis and opinions that Google pays [redacted] TAC on Search ads for Android phones than it does for Search ads viewed on other phone platforms (such as the iPhone). For calculations that rely on the TAC difference between Android phones and other phones, I adopt the TAC [redacted] percentage of [redacted] from GOOG-00130338 – 346, at 343.[52] I note that this document is from 2015. The relative TAC on Android versus other platforms may have varied over time. However, since I do not have data on relative TAC for other periods, I assume this difference applies across all years.

## 8. Disgorgement: Non-infringing Alternatives and Apportionment

34. Mr. Malackowski and Dr. Leonard agree that disgorgement damages are "any profits of the infringer that are attributable to the infringement and are not taken into account in computing actual damages."[53]

35. Dr. Leonard argues that in calculating disgorgement damages, it is necessary to determine the infringer's next-best non-infringing alternative, and to compare the profits the infringer actually made (due to the infringement) with the profits the infringer would have made had

[52] The document states that the TAC on iOS is [redacted] while the TAC on Android is [redacted], a difference of [redacted] The document also reports that the average annual margin on an Android device is [redacted], and the [redacted] (relative to an iOS device) is [redacted].

[53] Both citing 17 U.S.C. §504(b). See Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 11 and Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 15. Dr. Leonard sometimes refers to disgorgement damages as "unjust enrichment," a term to which Mr. Malackowski objects (see Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), pp. 137-139).

it employed its next-best non-infringing alternative.[54] Mr. Malackowski argues that consideration of non-infringing alternatives has no place in a disgorgement calculation, and cites an order of this Court to the same effect.[55] On the other hand, Mr. Malackowski does employ an "apportionment" of his calculation of Android profits, and states that the apportionment should be based on the "relative value" of the copyrighted work to the value contributed by the rest of the work.[56] The apportionment Mr. Malackowski performs is similar to the process of subtracting But-For profits under the assumption that, absent infringement, Google would not have pursued the Android project at all, which Mr. Malackowski appears to believe was Google's next-best non-infringing alternative. Thus, Mr. Malackowski in effect does consider a non-infringing alternative, albeit a specific alternative: Google not pursuing Android at all. I do not have a position on the legal issue of whether non-infringing alternatives can be considered in a disgorgement analysis, and if so, which alternatives are allowed to be considered. However, as an economist it seems sensible to allow (indeed, to require) consideration of the next best non-infringing alternative. If the measure of disgorgement damages is the profits attributable to the infringement, then this naturally seems to call for an apportionment of the total profits of the infringing product between those that are due to the infringement and those that are due to other factors. And this

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[54] Four of the five disgorgement alternatives Dr. Leonard offers rely on consideration of a non-infringing alternative. (Deposition of Dr. Gregory K. Leonard, March 11, 2016, pp. 48-49.) See also Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 20: "In the context of this case, assessing whether there is a causal nexus between Google's use of the SSO and declaring code of the 37 API packages ("the allegedly infringing material") and a particular revenue stream first requires an analysis of Google's best course of action had it not used the allegedly infringing material. Then, the counterfactual revenue stream and profits that Google would have earned taking its best course of action can be analyzed to determine the extent of the causal nexus, if any."

[55] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 139 and Doc. 632 "Order Granting in Part and Denying in Part Motion to Exclude Portions of the Expert Reports of Gregory K. Leonard and Alan J. Cox", November 28, 2011, pp. 6-7.

[56] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 269-305.

apportionment seems to naturally call for a But-For analysis and a specification of a non-infringing alternative.

36. A starting point for all of Mr. Malackowski's and Dr. Leonard's disgorgement analyses is a calculation of the revenues that Google has made on Android devices and the costs that Google has incurred in generating these revenues. Both Dr. Leonard's and Mr. Malackowski's report exhibits include financials for valuing Android's revenues, costs, and profits, and for much of the financial data they find consensus.[57] They differ in opinion on 1) the amount of TAC related to search ads on Android, 2) Android G&A Expenses, and 3) Incremental Search and Advertising Expenses.[58] See Exhibit 2 for a comparison of Dr. Leonard's and Mr. Malackowski's Android financial performance. For my report, I adopt Dr. Leonard's estimates of TAC, Android G&A, and Incremental Search and Advertising Expenses. While the TAC issue has not been clearly articulated in the discovery phase of this litigation, Dr. Leonard's TAC rates appear to be more in line with historical TAC rates when Google tracked Android TAC rates separately, but I acknowledge that the burden is on Google to prove costs.[59]

37. As for the G&A expenses related to overhead (real estate, HR, and financial/accounting resources), it is unlikely that Google could have created Android without incurring a measurable amount of overhead costs, given the number of engineers working on the Android project. While small changes in the Android market share may not have affected the G&A expenses, large changes (i.e. Android existing or not) would almost certainly have created G&A expenses for Google. Dr. Leonard allocates a portion of Google's G&A expenses to

[57] See Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1a.1 and Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Revised Exhibit 7.

[58] See Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 64.

[59] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 13.

Android using the ratio of Android engineers to all-Google engineers.[60] For purposes of my analysis, I adopt Dr. Leonard's methodology.

38. Finally, the incremental search and advertising operating expenses follow a similar reasoning to the G&A expenses; for large changes in advertising revenue, there would likely be observable changes in the search and advertising operating expenses. Here, Dr. Leonard used a regression to estimate the portion of search and advertising operating expenses to allocate to Android.[61] Again, for purposes of my analysis, I adopt Dr. Leonard's methodology.

39. Dr. Leonard considers several non-infringing alternatives in his disgorgement analysis.[62] He first looks at three cost-avoidance alternatives, or what he terms "Bottom Up Approaches," to calculate what costs Google would have incurred if it had not infringed the 37 Java APIs, but had undertaken costly actions to maintain the same level of app availability on the non-infringing Android as was available on the actual (infringing) Android.[63] He then alternatively considers how much market share Google would have lost if it had not used the 37 Java APIs (and made no costly mitigating efforts).[64] He also presents two "Top Down Approaches" to apportioning the Android profits into infringing versus non-infringing factors based on lines of code in Android alone (the first approach).and then lines

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[60] See Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, Exhibit 1e.

[61] Dr. Leonard noted in his deposition on March 11, 2016, pp. 342-343 that while the G&A expenses could be estimated by headcount (because the engineers were discretely assigned to Android/non-Android projects), the search and advertising employees were not so cleanly divided between Android originating traffic and non-Android originating traffic. Thus, he turned to a regression to estimate Android's incremental search and advertising expenses.

[62] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 174-196.

[63] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 174-184.

[64] Leonard utilizes the Kim model of smartphone demand based on availability of features, as described in Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 185-196.

of code in all of Android *and* all of Google's primary search code base.[65] These "Top Down Approaches" do not rely on a specification of a non-infringing alternative.[66]

40. To facilitate the discussion, it is useful to specify my definition of disgorgement damages. The disgorgement formula is:

Disgorgement Damages = Actual Profits – But-For Profits.

Since Profits = Revenue – Costs, the above formula can be written:

Disgorgement Damages = [Actual Revenue – Actual Costs] – [But-For Revenue – But-For Costs].

41. Thus, disgorgement damages arise when either But-For Revenue is less than Actual Revenue or when But-For Costs are greater than Actual Costs. In evaluating disgorgement damages, each potential non-infringing alternative can be evaluated for its impact of either But-For Revenue or But-For Costs.

### 8.1. Next Best Non-Infringing Alternatives

42. I describe each alternative suggested by either Mr. Malackowski or Dr. Leonard below. Ultimately, what Google would have done, absent infringement, is a fact issue for the jury.[67] Thus, I present below an estimate of disgorgement damages for each potential alternative.

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[65] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 197-202.

[66] In his Exhibit 1a.3 Dr. Leonard does calculate the difference in total actual Android profit and the Google profit under the non-infringing alternative of not developing Android at all (the non-infringing alternative advocated by Mr. Malackowski and Professor Jaffe). Dr. Leonard calculates this difference to be [redacted]. However, he does not present this analysis and amount as one of his opinions on disgorgement damages.

[67] And, as noted earlier, which, if any, of the But-For approaches is not legally permissible is a matter for the Court.

#### 8.1.1 Next Best Non-Infringing Alternative #1: OpenJDK

43. Dr. Leonard argues that Google could have written Android using the Java APIs, but under an OpenJDK license; that doing so would have had no impact on Android market share (i.e., no impact on the willingness of OEMs and Carriers to use Android); and that this would have cost a modest amount ($85,000).[68] In the disgorgement formula above, But-For Revenues equal Actual Revenues, and But-For Costs exceed Actual Costs by the amount of the re-programming effort ($85,000). Thus, if the jury were to conclude that this alternative would have been available and feasible and, importantly, would have had no impact on the market acceptance of Android, then disgorgement damages would equal $85,000.

44. Mr. Malackowski and Professor Jaffe (and other Oracle experts, including Dr. Murray and Dr. Schmidt) argue that the option of licensing Android under the OpenJDK license was not a viable economic or technical alternative to Google.[69] They assert that the OpenJDK license had terms that would have made Android unacceptable to OEMs and carriers, or at least uncertainty about the terms of the open source license under which OpenJDK was licensed would have made OEMs and carriers reluctant to adopt Android. Mr. Malackowski also notes that Google (allegedly) considered but rejected the use of an OpenJDK license for Android.[70]

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[68] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 175-178.

[69] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 143-151; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 26 and 440-448; Expert Report of Professor Douglas C. Schmidt, Ph.D., February 8, 2016, paras. 251-310; and Rebuttal Expert Report of Gwyn Firth Murray, February 8, 2016, paras. 21 and 124-140.

[70] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 142-153: "…OpenJDK was not a viable economic or technical alternative for Google and the record evidence shows that Google rejected it because it wasn't a commercially viable alternative."

45. I do not have an opinion on the legal issues related to what obligations and terms an OpenJDK license may have imposed on Google or on OEMs and carriers who chose to deploy Android-based products that were subject to an OpenJDK license. Nor do I have an opinion on the perception of what these obligations and terms may have been at the time that Android was launched. I do note however, that Google only very recently apparently introduced a version of Android licensed under the OpenJDK license.[71] As an economist, it strikes me as important that Google has not undertaken this action until now. Given the amount of litigation risk it faced, if an OpenJDK license was as good as a "regular" license to the asserted copyrights, and this could be accomplished for less than $100,000, I would have expected Google to have transitioned to an OpenJDK license much sooner. Likewise, as an economist, that Google chose not to use the OpenJDK when it began an expected-to-be-costly development of Android but instead opted to incorporate the 37 Java APIs, suggests that Google must have believed that the actual and expected costs of using OpenJDK were substantial.

#### 8.1.2 Next Best Non-Infringing Alternative #2: Train Developers in Alternative Programming Language

46. Dr. Leonard argues that Google could have written Android in another programming language (or otherwise not used the 37 Java APIs) and offered training to potential app programmers in this alternative programming language (such as C/C++).[72] Dr. Leonard asserts that by offering a 2-credit hour training course at a cost of $715 per enrollee to 3,155 programmers, Android would have obtained the same number of developers to develop

[71] See, for instance, Document 1412; stating that on December 24, 2015 Google released new versions of Android platform that are expressly licensed under the free, open source license provided by Oracle as part of its OpenJDK project. It is not clear whether all future versions of Android will be licensed under the OpenJDK license – and thus carriers and OEMs will be forced to accept whatever are the terms and obligations of that license if they continue to use Android – or whether Google will offer alternative versions of Android.

[72] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 140-145 and 179-181.

the same number of apps and thus the same market acceptance.[73] Dr. Leonard assumes only 3,155 programmers would need to be trained, with each developer working with an average of 1.6 programmers, and that Google would need to train programmers in numbers sufficient to have the same number of developers and thus the same number of apps as when the Java language was used.[74] The total cost of this training effort, according to Dr. Leonard, would be $2,255,968.[75]

47. The disgorgement calculation under this alternative is similar to the first cost-avoidance alternative Dr. Leonard offered. Since there is no impact on Android market acceptance, But-For Revenue equals Actual Revenue. But-For Costs exceed Actual Costs by the amount $2,255,968.

48. Mr. Malackowski argues that Dr. Leonard vastly understates the cost to Google to train developers to program in an alternative programming language.[76] Mr. Malackowski claims

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[73] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 145 and 180.

[74] Dr. Leonard looked at daily data for the top 100 applications on Google Play from 2012-2015 and found that 1,889 developers were responsible for developing those apps. Note that this figure is limited to *only* the top 100 apps each day, so to the extent there are additional applications offered on Google Play that never cracked the top 100, but that add value to Android, these sub-100 ranked apps are not accounted for in Dr. Leonard's developer count. He then omits developers who would not need to be trained in C/C++ because they already demonstrated use of it in developing their application, or those who "multi-homed on iOS and thus had demonstrated an ability to develop in multiple languages", reducing the headcount to 986 from 2012-2015 (Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 180). He doubles the count to 1,972 to estimate the doubled time period of 2008-2015. Dr. Leonard then multiplies 1.6 programmers per developer, based on the 2008 Android Developer Challenge list of entrants and named developers in the challenge. Note that some of the "programmers" in the Android Developer Challenge are not names of a single person, but instead a business name which could include more than one programmer. Another way the ratio of programmers to developers would be understated is if this particular Android Developer Challenge was geared toward amateur developers with fewer programmers, while the actual top 100 apps in the Google Play store were developed by larger teams or companies of programmers. Finally, Dr. Leonard multiplied the estimated number of programmers by the tuition cost for a single 2 credit hour online C/C++ class from Berkeley.

[75] See Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3c.

[76] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 159-162.

that a 2-credit hour course of C/C++ would not make developers proficient in developing apps in that language. Mr. Malackowski also claims that Dr. Leonard assumes each app on average requires 1.6 developers, while the number of developers per app is typically much higher.[77] Finally, Mr. Malackowski notes that Dr. Leonard only focuses on the Top 100 apps and assumes that if a non-infringing Android had only those apps available, its market acceptance would be unaffected as compared to the infringing Android with hundreds of thousands of apps available.[78]

49. I find that Mr. Malackowski's critiques have merit. Most importantly, Dr. Leonard focuses on the cost to Google to ensure that the Top 100 apps would be available on Android. However, as I understand the Oracle theory, the value to Google of using the 37 Java APIs is that it allowed a large number of existing Java developers to be already-trained potential app developers for Android, that this allowed Android to have a large number of apps developed quickly, and that this large number of apps was important to the acceptance of a new smartphone platform such as Android. Thus, it is not (only) the availability of the most popular apps that is important; smartphone users also care about the number of other less popular apps. In a sense, Oracle appears to be arguing that smartphone users *ex ante* prefer the option of having a lot of apps available, even if any individual user *ex post* uses

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[77] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 161. Mr. Malackowski compares the number of developers at King Digital (an app development company) with the number of Top 100 apps developed by King Digital. While Mr. Malackowski does not make the point explicitly, a limitation of Dr. Leonard's analysis is that, even if developing an app takes on average 1.6 developers, most apps that are developed do not turn out to be Top 100 apps. Thus, the number of developers required to have one Top 100 app would be much larger than 1.6. For instance, if the probability of an app being a Top 100 app is 1% (which may be too high), and on average it takes 1.6 developers per app, then the number of developers on average that are required to produce a Top 100 app would be 160. Note that this calculation assumes that each developer only develops one app, which is clearly wrong, but I think the example still has merit. Since most apps do not become Top 100 apps, the number of developers to develop any app understates the number of developers needed to ultimately produce a Top 100 app.

[78] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 162.

only a small number of apps. While I do not endorse or reject the Oracle theory, I note that Dr. Leonard's "training cost" calculation is not a solution to the problem that Oracle's theory posits.

50. The usefulness of Dr. Leonard's analysis is further undermined by his focus on the number of apps in the Top 100 list, rather than the number of apps (and the number of app developers) that would need to be developed in order to ensure that a Top 100 app was available on Android. As an example, Bubble Mania is a Top 100 app written, in my understanding, in Java.[79] However it is not obvious why Bubble Mania is so popular relative to thousands of other games that haven't become hits. Since it seems highly unlikely that Google could have predicted that Bubble Mania would be such a hit, it would not be sufficient for Google to train 1.6 developers so that they could develop Bubble Mania, and thus ensure that this popular game was available on Android. Rather, Google would need to train a large number of developers, who would need to write many games in order to reasonably ensure that whatever games did become popular were available on Android. In short, Dr. Leonard is focusing solely on ex post successful apps and is thereby implicitly assuming that Google could have, ex ante, "picked the winners." This seems highly unlikely. To get a handful of winners, it's far more likely that there would need to be lots of apps in the "race" for one of them to become a hit. In which case, the costs to Google of pursuing this alternative would be an order, or several orders, of magnitude larger than Dr. Leonard's estimate.[80] See Exhibits 3a and 3b.

51. Focusing on the Top 100 or any other measure of "highest number of downloads" also misses the potential importance of offering apps that are specific to (heterogeneous) interests. The success of a platform may also depend upon being able to provide a very large

[79] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 2b.

[80] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 169.

number of apps, no one of which is important to a large fraction of platform users, but each of which is important to a (potentially small) subset of platform users.[81] For example, very few people are backcountry skiers. Yet for backcountry skiers, being able to connect to an app that evaluates and forecasts avalanche dangers is very important and Android is likely to be far more valuable if app developers can target the myriad interests of potential Android users.

#### 8.1.3 Next Best Non-Infringing Alternative #3: Subsidize App Development in Alternative Programming Language

52. Dr. Leonard argues that Google could have written Android in another programming language besides Java (or otherwise not used the copyrighted APIs) and then could have subsidized app development in the alternate programming language, resulting in the same number of available apps and the same market acceptance of Android.[82] Dr. Leonard asserts a range of $22,673 to $100,000 as a subsidy to each of the developers of 1,000 apps so that Android would have obtained the same number of apps and thus the same market acceptance.[83] Dr. Leonard chose 1,000 apps for his calculation because he estimates that 428 unique apps account for "the monthly top 200 most used apps during the January to March 2013 and January to March 2015 periods combined" and estimated 1,900 apps would make up the top 200 most used apps over the life of Android.[84] "Conservatively" omitting 65% of the apps due to non-Java language, Google development, or multi-homing development, Leonard calculates the subsidy that would be needed for a maximum 665

[81] Reply Expert Report of Professor Adam Jaffe, Ph.D., February 29, 2016, para. 95.

[82] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 146 and 182-184.

[83] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 147 and 183.

[84] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, footnote 277.

apps which he rounds up to 1,000 apps.[85] The total cost of this subsidy effort, according to Dr. Leonard would be $23 million to $100 million.[86]

53. The disgorgement calculation under this alternative is similar to alternatives 1 and 2. Since there is no impact on Android market acceptance, But-For Revenue equals Actual Revenue. But-For Costs exceed Actual Costs by a range of $23 million to 100 million.[87]

54. Mr. Malackowski argues that Dr. Leonard understates the cost of developing an app, and that Dr. Leonard's calculation assumes Google would need to subsidize the development of too few apps to maintain the market acceptance of Android.[88]

55. As an economic matter, I again find that Mr. Malackowski's critiques have merit. Dr. Leonard's focus on the top 200 apps does not address the assertion by Oracle that the broad availability of many thousands of apps was important to the market success of Android.[89] Additionally, Dr. Leonard again does not include in his analysis the probability that an app will be in the top 200 and the resulting larger number of apps whose development would need to be subsidized in order to ensure that all top 200 apps would be available on the Android platform.

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[85] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, footnote 277.

[86] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 184 and Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3b.

[87] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 184 and Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3b.

[88] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 166-170.

[89] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 162: "Android would need hundreds of thousands of apps available to be attractive to developers and consumers."

#### 8.1.4 Next Best Non-Infringing Alternative #4: Develop Android in Alternative Programming Language, with (Possibly) Fewer Apps Available and Lower Market Share

56. Dr. Leonard argues that Google could have written Android in an alternative programming language (or otherwise not used the 37 Java APIs in Android) and not undertaken any of the actions discussed directly above.[90] The impact of this choice would be a possibly smaller number of apps available on Android, and a possibly smaller market acceptance (and market share) of Android.

57. Determining the effect on Google profits under this alternative is more complex. When there are fewer Android mobile units (primarily smartphones, but also tablets) Google makes less money from ads served to users of Android devices. If there are fewer Nexus phones, Google also make less on phone sales. With fewer Android phones—either its own or those produced by OEMs using the Android platform— Google also makes less on Google Play sales.

58. The decreased revenues are somewhat offset by decreased costs, however. Google also does not pay TAC for the ad revenue that it does not receive when there are fewer Android units. Moreover, if Google does not sell a Nexus phone, it does not incur the cost of making that phone, and if Google does not sell an app or song or movie through Play, it does not pay the app developer or musician or movie owner.

59. The lost Android profits are partially offset in that when there are fewer Android units sold, there are likely additional units sold of other smartphones that generate revenues for Google. Some of those people who owned an actual Android phone, but would not own a But-For Android phone, will almost certainly instead own another smartphone. Google makes money on the searches and ads on these alternative platform smartphones (it does not make hardware sales or Google Play sales, however). Of course, Google also incurs

[90] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 185.

costs – specifically Traffic Acquisition Costs – for the ad revenue it receives from these "displaced" Android users. Since the TAC that Google pays on Android phones is less than the TAC it pays on ad revenue from other mobile platforms, Google makes less search-related profit when users switch from an Android phone to another smartphone, even when the amount of revenue Google receives from users' search activities remains the same.

60. Thus, in order to calculate disgorgement damages under this non-infringing alternative, one needs to estimate: (1) the reduction in Android market acceptance (units) due to the use of an alternative set of APIs; (2) how much Android revenues decrease due to the decrease in Android users; (3) how much Android costs decrease due to the decrease in Android users; (4) what alternative smartphones (on what platforms, i.e., iPhone, Blackberry, Windows Phone, etc.) these displaced Android users would use instead; (5) what revenues Google would receive from these displaced Android users; and (6) what increased TAC and other costs Google would incur from the displaced Android users.

#### 8.1.4.1 Android Market Share Decrease Due to Non-Java VM

61. Dr. Leonard employs a model of smartphone demand contained in the Economics PhD dissertation of Min Jung Kim.[91] One variable in Dr. Kim's model is the expected utility of

[91] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 186-195.

apps available on each smartphone platform.[92] Dr. Leonard applies the Kim model to estimate the decrease in market acceptance of Android if fewer apps were available on the Android platform.[93]

62. While the specifics of Dr. Leonard's application of this model are complex, the intuition is straightforward. First Dr. Leonard calculates the number of apps that have appeared on the daily Top 100 downloaded apps for Android over the period 2012 to 2015.[94] Dr. Leonard finds that there are a total of 3,642 unique apps that appear over this four-year period with an average of about 1,200 unique apps appearing in a given year.[95] Dr. Leonard then determines which of these Top 100 apps fit the following criteria:

    a) Google Apps: Apps written by Google (such as Google Maps)

    b) C++ Apps: Apps that were written in C/C++ (i.e., written using the NDK)

    c) Dual-Home Apps: Apps that also are written for iOS

[92] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 189. The expected utility of available apps is a function of both the number of apps being considered as well as the share of downloads that each app has in a given month. It is common when describing this part of the Kim model to refer just to the number of apps that are available.

[93] See Exhibits 4a and 4f. Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 186. Again, when I refer to there being fewer apps, I mean a lower expected utility of the fewer apps that are available. Not all apps have the same weight in the model because some apps lend more to expected utility – these are the apps with a higher share of downloads per month. In other words, if you were to only remove one app, you would get a different effect from the model if the app were something like Facebook with several million downloads each month or Pixelbite's Mutant with 175 downloads and which only appears once in the top 10 during the 2012-2015 time period.

[94] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 191.

[95] Calculated from Dr. Leonard's "Exhibit 3d.3_apps.dta." Note that Dr. Leonard's data set associated with the top 100 apps has 16,178 observations. This is because in a given year, certain apps appear every month while other apps may appear only once. The Facebook app, for example, appears 48 times in his dataset because it is a top 100 app every month for the years 2012-2015.

d) Dual-Home Company Apps: Apps that were written for Android, but by a company that also writes apps for iOS

e) Dual-Language Company Apps: Apps that were written for Android, but by a company that writes other apps using the NDK. [96]

63. Dr. Leonard asserts that an app fitting any one of the above five criteria is an app that would be available on Android even if Android did not use the 37 Java APIs. Basically, Dr. Leonard argues that the ability to write the app in Java would not be important to having the app available on Android since either the app was not written in Java or the developer of the app had the demonstrated ability to write apps in a language other than Java. The five criteria as presented above can be thought of as being in descending order of the probability that they would hold in the counterfactual world, with a Google app being the most likely to be available in the But-For world and a Dual-Language Company app being less likely relative to a Google app. I am not asserting a position on whether Dr. Leonard's five criteria make sense with regard to what would be available to a But-For Android phone user, but I do test the sensitivity of his results to the five criteria.

64. After imposing the five criteria for app inclusion, approximately 1,000 apps are dropped from the 3,642 Top 100 apps in the analysis (said another way, Dr. Leonard's analysis considers the impact of having removed about 23% of the apps).[97] Dr. Leonard uses the Kim model to estimate the decrease in market demand for Android phones for not having

[96] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 192. See also Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 2i.

[97] Dr. Leonard asserts in his deposition that he only uses the first three of the five criteria. (See Deposition of Dr. Gregory K. Leonard, March 11, 2016, pp. 370-371). This description appears to match my Scenario 2 as discussed later in this report at para. 67. However, Dr. Leonard's STATA code clearly uses all five of the criteria to arrive at his results. See Exhibit 3d.3.do from the Leonard backup materials and Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 192.

these apps available. For 2012, he finds that this decrease in the number of Android handsets purchased by consumers would be about 1.9% worldwide (about 9 million units of the 501 million units) and this reduction in Android handsets translates into a damages number of $202.6 million.[98]

65. Mr. Malackowski and Dr. Jaffe raise several objections to Dr. Leonard's use of the Kim model.[99] Putting aside the non-technical critiques by Mr. Malackowski and Professor Jaffe of Dr. Leonard's analysis, I believe that a limitation on the results of Dr. Leonard's analysis is that it focuses on the availability of Top 100 apps and the effect on Android sales. As noted previously, this focus does not address the core Oracle allegations that the use of the 37 Java APIs allowed a much larger number of miscellaneous apps (not limited to the most popular apps) to be available quicker, and that the greater app availability allowed Android to succeed where it otherwise would not have succeeded (or to obtain market share faster than it otherwise would have obtained it). Thus whether, and to what degree, a reduced number of top apps would have affected the demand for Android phones is not exactly the right question (even if Dr. Leonard has a reliable method for answering the

[98] See Exhibit 4a.1. See also Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 3d.1, 3d.3, and 3d.5.

[99] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 45-62; Reply Expert Report of Professor Adam Jaffe, Ph.D., February 29, 2016, paras. 70-86. Several of the criticisms put forward by Mr. Malackowski and Professor Jaffe do not go to the economics of the model, namely, Mr. Malackowski raises questions about whether the Kim model has been peer-reviewed and whether a discrete choice model may be used to calculate damages in litigation. To these points I would say, first, that a doctoral dissertation is carefully reviewed by the academic committee supervising the Ph.D. student and Dr. Kim's degree is from a respected program. Second, the discrete choice model is accepted within the economics community with the person who brought it to the discipline, Daniel McFadden, having earned the Nobel Prize for his work. Furthermore, the Berry model used by Dr. Leonard has been not only peer-reviewed but also cited in other peer-reviewed articles over 500 times. I have no reason at this juncture to criticize the economic theory behind what Dr. Leonard has presented. However, I am unable to address certain facets of Dr. Leonard's work because the data used to estimate the Kim model are not available to test. For example, I have not been able to test whether the coefficients relied upon by Dr. Leonard might vary over time. As a result, I have provided various sensitivity tests to Dr. Leonard's calculation of alternative market shares and diversion ratios as will be shown later in this report.

question he posed). On the other hand, the way the Kim model works is that platform market shares are a function of the *weighted* availability of apps on that platform, with the weights determined by the popularity of the app (measured by the relative number of downloads of that app). Thus, the impact on platform market share of not having a few very frequently downloaded apps available might be similar to the impact of not having very many infrequently downloaded apps. Of course, the equivalence point depends on the number of apps in each "removal bucket" and the download frequency of those apps.

66. Nevertheless, and without getting into the complexity of Dr. Leonard's adaptation of the Kim model, I have tested the sensitivity of his results to three factors or parameters: (1) the number of apps available on Android, (2) the β coefficient he uses from Kim's model, and (3) the σ estimate from Kim's model. I find that Dr. Leonard's damage numbers are sensitive to each of these elements of his analysis and I detail this sensitivity in Exhibits 4a.1, 4a.2, 4c.1, 4c.2, 4d.1, 4d.2, 4e.1, and 4e.2.

67. With regard to the number of apps available, I tested the sensitivity of Dr. Leonard's model to having a differing number of apps available in his non-Java VM counterfactual. Specifically, instead of having all apps that meet Dr. Leonard's criteria for inclusion as noted above, I systematically remove these inclusion criteria starting with the fifth criteria – Dual Language Company apps.[100] By sequentially removing these criteria, the number of applications that are available in a counterfactual scenario is reduced. From this, I define three scenarios, namely:

    a. Scenario 1: In addition to eliminating the apps that Dr. Leonard removes in his analysis, I remove the Dual-Language Company criteria for inclusion.

[100] I am not making any assertion here about whether apps from any of Dr. Leonard's five criteria would or would not be available in a non-Java VM world. I'm merely using these categories to remove apps to see how fewer apps impacts Dr. Leonard's damages number.

b. Scenario 2: Cumulative to Scenario 1, I remove the Dual-Home Company inclusion criteria.

c. Scenario 3: Cumulative to Scenario 2, I remove the Dual-Home inclusion criteria.

68. In Scenario 1, I found that the Dual-Language Company criteria affected very few apps and that there was virtually no difference in any of Dr. Leonard's estimates after removing them. This can be seen in Exhibit 4a.1.

69. In Scenario 2, I removed the Dual-Home Company criteria from Scenario 1. This resulted in 50% of the apps being unavailable in the But-For world (as compared to the 23% that Dr. Leonard determined in his analysis). Reducing the number of apps to this level results in Dr. Leonard's model estimating an approximately 8% loss in Android users which results in damages of about $930 million.[101]

70. Finally, in Scenario 3, I removed the Dual-Home criteria from Scenario 2. This resulted in only 10% of the apps remaining in the model. In this scenario, there would be an approximately 20% loss in Android users and an estimate of damages of more than $3.5 billion.[102]

71. Next, I tested the sensitivity of Dr. Leonard's analysis to the two parameters from the Kim model, namely the β and σ coefficients, which are measures of particular elements of the app market to consumers. Both of these parameters impact Dr. Leonard's measurement of the percent of lost Android users and his diversion ratios. However, roughly speaking, β has a larger impact on the percent of lost Android users and σ has a larger impact on the

[101] See Exhibit 4c.1.

[102] See Exhibit 4c.2.

diversion ratios. Exhibit 4a.1 shows these impacts for alternative estimates of β and σ.[103] As the β coefficient decreases, damages decrease and as β increases, the damage estimate increases; likewise, as σ moves up or down it affects damages. These effects can be seen in Exhibits 4a.1, 4a.2, 4e.1, 4e.2, and 4e.3.

72. I note that neither Mr. Malackowski nor Professor Jaffe offer an alternative estimate of the decrease in market share that would be experienced by a non-infringing Android, although some of their statements suggest that they believe a non-infringing Android would have zero market share.[104] In the previous phase of this litigation, Professor Cockburn estimated that the decrease in market share of a version of Android that did not use the 37 Java APIs would range from 8% to 19%.[105] This conclusion was based on a conjoint analysis by Dr. Shugan, wherein he tested the decrease in willingness to pay by smartphone consumers when the number of apps decreased from 100,000 to 40,000 and 6,000.[106] Dr. Cox adopted a mid-point of Professor Cockburn's estimates and assumed for his opinions that the reduction in market share that a non-infringing Android would experience was 13.55%.[107]

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[103] I test values of β and σ that are within a typical 95% confidence interval given the standard errors around which each are measured. The standard error on β is 0.004 (as noted in Kim's Table 2.7) and the standard error on σ is 0.075 (as noted in LEONARD0000001.pdf).

[104] See, for example, Reply Expert Report of Professor Adam Jaffe, Ph.D, February 29, 2016, paras. 28-29 and 35. See also Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 60: "Assuming Android would have existed without Google's infringement is also speculative."

[105] Expert Report of Dr. Iain M. Cockburn, Revised September 15, 2011, para. 472. I realize that portions of the expert opinions in the previous litigation were ruled inadmissible by the Court, and that these rulings implicated some of the analyses I discuss here. To the degree my referencing of these previous analyses and conclusions is inappropriate, this discussion should be deleted.

[106] Expert Report of Professor Steven M. Shugan, September 12, 2011, pp. 9, 14, Appendix D, and Exhibits 3a and 4a.

[107] Expert Report of Dr. Alan J. Cox, Revised April 15, 2012, pp. 41 and 58.

73. I conclude a likely decrease in Android market share due to a smaller number of apps available would be a range of 13.55% to approximately 20% (the percentage varies year to year). Using Dr. Leonard's diversion ratios, recapture rates, and cost estimates results in damages between $2.08 billion and $3.51 billion as shown in Exhibits 4g and 4c.2.[108]

#### 8.1.4.2 Change in Android Profits Due to Decreased Android Market Share

74. Dr. Leonard calculates the change in Google profits from a decrease in Android market share by first reducing Google Search ad revenues from Android phones proportional to his estimated market share decrease. He also decreases Google Play and Google Android hardware revenues proportional to the estimated market share decrease and diversion ratios. Dr. Leonard then reduces the costs associated with these revenue categories (TAC, content costs for Google Play revenues, and COGS for Hardware revenues) proportional to the revenue decreases in each. He does not adjust downward Android Operating Expenses (doing so would slightly increase his estimated damages total). This is a reasonable assumption given the relatively small market share decrease he considers; for larger market share decreases it may be appropriate to adjust Operating Expense in proportion to the decrease in Android revenues.[109]

75. In estimating the profit impact on Google, Dr. Leonard estimates the percent of "lost" Android users who would switch to an iPhone, and the Search ad profits that Google would make from these additional iPhone users. He uses the diversion ratios from the Kim model to estimate that between 40.5% and 44% of the lost Android revenue would return via the

[108] The 13.55% reduction in market share noted above does not vary by year. Using that number in all years results in damages of $2.08 billion as shown in Exhibit 4g. For comparison purposes, using a 20.7% reduction (which is the weighted average market share reduction in Exhibit 4a.2 for Scenario 3) results in damages of $3.18 billion and is shown in Exhibit 4h.

[109] For Exhibits 4a.1, 4a.2, and 4c.1 - 4e.2, I have followed his convention for the sake of comparison.

diversion of users to the iPhone.[110] Dr. Leonard assumes that these new iPhone users would have the same search intensity as they did when using an Android phone thus the "per phone" Search ad revenue would be unchanged. However, Dr. Leonard assumes that the TAC that Google pays Apple for this Search ad revenue would be higher than the TAC that Google pays for Search ad revenue on an Android phone.[111]

76. I find that Dr. Leonard's cost change calculations are reliable and accurate. If anything, these calculations likely overstate the profit loss to Google from a decrease in Android market share. Dr. Leonard assumes that about half of the "lost" Android users would switch to an iPhone, while the remainder would do something else (switch to another smartphone, switch to a feature phone, or have no phone at all). Dr. Leonard assumes that Google would not recapture any search ad revenue on any of the "lost" Android users who do something else. This is likely incorrect. Many of these users would likely switch to a Windows Phone or a Blackberry or some other mobile platform (such as are listed anonymously on Case No. CV 10-03561 WHA, Response to Docket No. 1436, "Google Search Distribution Agreements with Non-Android Mobile Operating System Partners"), and Google would be expected to earn Search ad revenue on these non-iPhone alternative platforms. Thus, Dr. Leonard's calculations likely overstate the decrease in Google profit from a decrease in Android market share.

[110] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3d.2. See also Exhibits 4c.3, 4d.3, and 4e.3.

[111] Dr. Leonard assumes that the Google TAC for search ad revenue on an Android phone is 15%, while the TAC for search ad revenue on an iPhone is 36%, based on GOOG-00130338 at 343.

### 8.1.5 Next Best Non-Infringing Alternative #5: Do Not Develop Android at All

77. Mr. Malackowski and Professor Jaffe conclude that another non-infringing alternative from Google would have been to not pursue the Android project at all. Mr. Malackowski concludes that the total profits Google has made from Android total [redacted] He then uses a [redacted] apportionment factor to arrive at his disgorgement damages estimate of [redacted][112] Mr. Malackowski does not attempt to calculate the But-For profits that Google would have made without Android, and argues that consideration of But-For alternatives in a disgorgement analysis is inappropriate.

78. Dr. Leonard does not explicitly consider this non-infringing alternative in his disgorgement alternatives, although he does calculate the difference in Actual Google Profit (with Android) and But-For Google profit (without Android) in his Exhibit 1a.3. He concludes that the incremental profit that Google has received, from having Android, is [redacted]

79. As noted above, I believe that the correct economic method to calculate the profits attributable to the infringement is to compare actual profits to But-For profits under the next best non-infringing alternative. Thus, if the next best non-infringing alternative is "no Android" I would perform a calculation identical to that in Dr. Leonard's Exhibit 1a.3.[113] In performing this calculation, I believe Dr. Leonard is correct to deduct the total Android Engineering PM costs, Android Legal Costs, and Incremental Search and Advertising Expenses. If Google had not pursued the Android project at all, these costs would not have been incurred.

[112] Responsive Expert Report of James E. Malackowski (Corrected) February 29, 2016, Figures 12 and 13.

[113] Dr. Leonard's Exhibits 1a.3 and 1b (iPhone Recapture Adjustment) are presented here as Exhibits 5a and 5b.

# 9. Lost Profits

## 9.1. Mr. Malackowski's Lost Profits Model

80. Mr. Malackowski concludes that the adoption of Android has caused Oracle to experience declining license revenues from licenses of Java ME. Mr. Malackowski's lost profits analysis is straightforward. He begins with a Sun two-year forecast of Java ME licensing revenues. However, there is some confusion on the date of this forecast. Mr. Malackowski states the forecast was performed in 2008.[114] There was also confusion about this in the previous phase of this litigation.[115] Whatever the date of the forecast, the document forecasts Java ME licensing revenues for the years 2009 and 2010. Mr. Malackowski extends this revenue forecast through 2015 by assuming that, for years after 2010, Java ME revenues would grow at the same annual rate as they were forecasted to grow between 2009 and 2010 (8.3%).[116] Mr. Malackowski subtracts in each year the actual Java ME license revenues from his calculation of projected Java ME license revenues. He then deducts from these lost revenues his estimate of the incremental costs that Sun or Oracle would have incurred in generating these incremental revenues, to estimate lost profits in each year. He sums his estimated lost profits for each year, and does not perform any discounting, adjustment for risk or present value calculation. Estimated Java ME lost profits through

[114] Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 186.

[115] Dr. Cockburn does not explicitly report the year of the forecast. Dr. Cox refers to it as a "2007-2008" forecast (Expert Report of Dr. Alan J. Cox, Revised April 15, 2012, p. 48). Professor Kearl's previous report referred to it as a 2007 forecast (see Expert Report of Professor James R. Kearl, Revised March 28, 2012, para. 127). Dr. Leonard refers to it as a "late 2007/early 2008" forecast (Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 235). Mr. Malackowski states that it was "created in 2008" (Expert Report of James E. Malackowski, January 8, 2016 (Corrected), para. 186).

[116] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibit 12.3.

2016 total $475.4 million. Mr. Malackowski does not provide an estimate of Oracle lost Java ME profits after Oracle FY 2015.

### 9.2. Dr. Leonard's Objections

81. Dr. Leonard raises several objections to Mr. Malackowski's lost profits analysis. These include: (a) the use of an incorrect baseline forecast; (b) that Mr. Malackowski's estimated lost revenues are not related to the volume of Android phones shipped; and, (c) that Java ME does not compete with Android, so Oracle cannot have lost Java ME revenues and profits due to Android. Dr. Leonard does not take issue with Mr. Malackowski for not discounting his lost profits estimate, and does not apply discounting to his alternative lost profits models (that are discussed below).

### 9.3. Which Java ME Forecast is Most Appropriate

82. First, Dr. Leonard objects that the Sun document upon which Mr. Malackowski relies for his forecast actually contains four forecasts of Java ME revenue; a Low, Medium, and High forecast, in addition to the "Strategic" forecast used by Mr. Malackowski.[117] Dr. Leonard argues that the Strategic forecast chosen by Mr. Malackowski has the highest forecasted Java ME revenues (and thus results in the largest lost profits damages), and instead advocates performing the lost profits calculations using an alternative forecast. Dr. Leonard notes that using the High forecast results in estimated lost profits of much lower damages, and using the Low or Medium forecasts result in negative damages.[118]

[117] The document containing these forecasts explicitly labels the Low, Medium, and High forecasts as such. The forecast used by Mr. Malackowski is not explicitly labeled, but has been referred to as the Strategic forecast. I adopt that label for my discussion.

[118] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, para. 274.

83. Mr. Malackowski replies that the Low, Medium, and High forecasts all reflect to some extent the expected impact of Android on Java ME licensing revenues, and thus are not appropriate bases for a "But-For" estimate of Java ME revenues had Android not been introduced.

84. A similar debate regarding the appropriate forecast took place in the previous stage of the litigation between Professor Cockburn and Dr. Cox. As I noted then, and still believe, ultimately the jury will have to decide whether and to what extent the various forecasts reflect the expected impact of Android on Java ME licensing revenues.[119] If the jury finds Mr. Malackowski's arguments persuasive on this issue, then it should base its damages award off calculations based on the Strategic forecast. If it finds Dr. Leonard's arguments persuasive, then a lost profits calculation based on the Low, Medium, or High forecast is appropriate.

85. As discussed below, however, I believe Dr. Leonard's alternative lost profits model to be a useful way to estimate Java ME lost profits, and that model does not rely on any Java ME forecast. Moreover, I present another alternative method of estimating Java ME lost profits (a refinement of the Leonard model) that also does not rely on Sun forecasts of future Java ME revenues. Thus, my preferred approach to estimating lost profits would not reach the question of which of the competing revenue forecasts is most appropriate.

### 9.4. Java ME Lost Profits Not Related to Android Volumes

86. Dr. Leonard also notes that Mr. Malackowski's estimated Java ME lost profits do not appear to be related to the number of Android mobile devices sold. If Android devices substituted for Java ME licensed devices, one would expect that there would be an at least rough relationship between Android sales and Java ME losses. Dr. Leonard points out that that

[119] Expert Report of Professor James R. Kearl, Revised March 28, 2012, para. 131.

relationship does not exist when using Mr. Malackowksi's damages estimates.[120] Mr. Malackowski counters that "Android does not have a static relationship with Java ME whereby a unit of Android on the market causes a specific level of Java ME lost profits."[121] Thus Mr. Malackowski rejects the argument that his annual lost profits amounts should be proportional to the number of Android units sold in each year.

87. Professor Jaffe describes how Android competed with and substituted for Java ME licensed devices. Professor Jaffe also stated that Java "…royalty payments generally relate to shipment volume of hardware containing the Java platform."[122] Thus, one might expect that in general Java ME losses would be proportional to Android sales. On the other hand, the market success of Android may have lowered Java ME revenues in two ways: it may have decreased the number of units on which Java ME license royalties were paid (a "quantity" effect), and it may also have decreased the Java ME royalty per unit (a "price" effect). While Mr. Malackowski does not explicitly make this "price erosion" argument, it appears to be implicit in some of his comments.[123]

### 9.5. Java ME does not Compete with Android

88. Dr. Leonard also argues that Java ME was used on, and appropriate for, feature phones and was not used nor was appropriate for use on smartphones, such as Android phones.[124] Thus, Dr. Leonard argues that Android does not compete with, or substitute

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[120] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, para. 271; Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 4a.

[121] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 174.

[122] Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 62.

[123] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 180, 184.

[124] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 211, 240, 244.

for, Java ME and increasing Android sales could not cause lost revenue from lower sales of Java ME licensed products. Mr. Malackowski and Professor Jaffe argue that Android does compete with Java ME and Android sales did displace sales of licensed Java ME units.[125] Among their rationales are that smartphones and feature phones are not discrete market segments but instead represent a continuum;[126] Android was used on some feature phones;[127] and that absent Android, Oracle would have continued to invest in and improve Java ME such that it would have become more appropriate for more modern smartphones.[128] They provide no support for the third claim, and their assertion that there is a continuum between feature phones and smartphones while perhaps true, does not really address the degree of competition, if any, between Android-based smart phones and Java ME-based feature and low end smartphones.

### 9.6. Dr. Leonard's Alternative Damages Model

89. Dr. Leonard presents two alternative Java ME lost profits calculations.[129] Both take a similar approach. Dr. Leonard assumes that Java ME license revenues in a year would be proportional to the number of "potential Java ME handsets" sold in that year. Dr. Leonard assumes that any feature phone or smartphone, except Android phones and iPhones, is a

[125] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 175; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), paras. 329-348.

[126] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 175; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 106.

[127] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), para. 175.

[128] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 21, 209, 216, 222-224; Reply Expert Report of Professor Adam Jaffe, Ph.D., February 29, 2016, para. 42; Expert Report of Professor Adam Jaffe, Ph.D., February 8, 2016 (Corrected), para. 348.

[129] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 4e and 4f.

potential Java ME handset. The effect of increased sales of Android phones is that Android phones substitute for other types of phones – phones that may be potential Java ME phones, thereby displacing the Oracle opportunity to license Java ME to these (displaced) potential Java ME phones.

90. To estimate the effect of Android sales on potential Java ME phones, Dr. Leonard has to estimate what phones Android users would choose, were Android not available. His first model uses the annual market share of other phones to estimate the But-For phone choice of Android users. (I call this Dr. Leonard's "market share model".) His second model uses the diversion ratios from his work with the Kim model to estimate the But-For phone choice of Android users. (I call this Dr. Leonard's "diversion ratio model".)

91. In his market share model, Dr. Leonard calculates the relative market share of iPhones versus all other non-Android phones (both smartphones and feature phones). He assumes that, but for Android, users of Android phones would instead have either an iPhone or a "potential Java ME phone" with a probability equal to the proportional market share of these two categories. Dr. Leonard then calculates how much these "additional" potential Java ME phones (that are represented by displaced Android phones) would increase the total size of the market for potential Java ME phones. He then estimates lost profits in that year using actual Java ME revenues times the percentage increase in the number of potential Java ME phones in that year.

92. A numerical example may be useful. In 2015[130] there were 1,962,186,444 handsets shipped, consisting of 588,789,919 feature phones[131], 218,333,678 iPhones, 1,104,512,243 Android phones, and 50,550,604 other smartphones. Dr. Leonard assumes

[130] Worldwide Handset Volumes are adjusted to reflect Oracle Fiscal Years. See Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 4f.

[131] IDC Data reflect Feature Phones as having an "RTOS" operating system. See IDC WW Quarterly Mobile Phone Tracker 2015Q3 Historical Release.

that all feature phones and all smartphones other than iPhones and Android phones were potential Java ME licensed handsets. Thus, the total actual market for Java ME in 2015 was 639,340,523 phones (588,789,919 feature phones, 50,550,604 other smartphones). Dr. Leonard estimates that of the 1,104,512,243 Android phones, 25.5% would be iPhones if Android were not available, while 74.5% would be either feature phones or other smartphones.[132] Thus, the 1,104,512,243 Android phones would, but for Android, have been 823,342,284 additional potential Java ME phones (or 74.5% of 1,104,512,243). This represents an increase in the number of potential Java ME phones of 128.8% (or 823,342,284/639,340,523). If Java ME revenues are proportional to the number of potential Java ME handsets, then absent Android, 2015 Java ME revenues would be 128.8% higher than the actual level. Actual Java ME revenues in 2015 were [redacted] the additional Java ME license revenues in 2015 would have been [redacted] or 128.8% of [redacted].

93. Applying the methodology described in the above year 2015 example to years 2009-2015, Dr. Leonard's Java ME market share model yields total Java ME lost profits of $128,516,178.

94. Dr. Leonard's diversion ratio model uses a similar logic. However, in this model he estimates what phones Android users would choose, should Android not be available, based on the diversion ratios from the Kim model. In this model, Dr. Leonard has a much greater percentage of Android users selecting an iPhone in his counterfactual than he does in his market share model. This result makes intuitive sense: a user of an Android smartphone is more likely to choose another smartphone, if Android is not available, than to choose a

[132] This is calculated in Leonard's Exhibit 4f as the ratio or share of "Potential Java ME Licensed Handsets" (Total Handset Units less Android and iOS Handsets) to "Non-Android Handset Units". See Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 4f.

feature phone. Because more Android users switch to an iPhone in this model than in his market share model, Dr. Leonard estimates lower Java ME lost profits of $85,729,274.[133]

95. The diversion ratios used by Dr. Leonard are derived from his application of the Kim model. As discussed above, I have some concerns regarding Dr. Leonard's application of the Kim model in determining the But-For market share of Android, if Android did not contain the 37 Java APIs and thus had fewer available applications. However, most of these concerns relate to the specified But-For number of apps available on a non-infringing Android, and the diversion ratios that result from the Kim model do not appear sensitive to this concern. Thus, of the two Leonard lost profits models, I would put more weight on the results of his diversion ratio model.

96. Although he does not describe his models in this way, in both of Dr. Leonard's models Java ME lost revenues are equal to the actual Java ME Revenue per Potential Java ME Licensed Handset in each year times his estimate of the number of Android units that would not be an iPhone in that year (that is, the number of new Potential Java ME Licensed Handsets). Thus, he implicitly assumes that the lost revenue in a year is equal to the Java ME revenue per eligible phone in that year (the "per unit price" of Java ME), times the number of additional eligible Java ME handsets that would have existed had Android not been available. This assumes that the But-For "per unit price" of Java ME in (say) 2015 would be the same as the actual per unit price in that year. This in turn assumes that the market success of Android did not cause Oracle to lower the price per handset of Java ME. This may not be correct.

[133] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 4e.

### 9.7. An Alternative Lost Profits Model Controlling for Price Erosion

97. Dr. Leonard's lost profits model can be modified to address the effect of price erosion in Java ME. The Leonard model's Java ME lost revenues are simply a multiplication of new potential Java ME licensed handsets times the actual Java ME revenue per potential Java ME licensed handsets in each year. The problem with this approach is that, if Android caused Oracle to lower the per unit royalty rate for Java ME licensed handsets, the actual Java ME revenue per potential Java ME licensed handset is not a good estimate of the But-For Java ME revenue per potential Java ME licensed handset. To address this issue, I calculate the actual Java ME revenue per potential Java ME licensed handset in 2009.[134] This is the year Mr. Malackowski begins his lost profits damages model and therefore is presumably a year when the Java ME license revenue per unit is relatively unaffected by Android. The actual Java ME revenue per handset is $0.08. I then hold this "price" constant and calculate lost Java ME profits by multiplying this price in each year times the number of new potential Java ME licensed handsets, as calculated under Dr. Leonard's diversion ratio model. This results in a lost profits total (not discounted) of $121,480,655.[135]

### 9.8. Discounting

98. It is customary to discount estimated lost profits to convert an uncertain stream of annual nominal losses into a certainty equivalent sum expressed in real (i.e., inflation adjusted) terms. Neither Mr. Malackowski nor Dr. Leonard employ discounting in their lost profits damages analyses, but I believe it is appropriate to do so. I employ the common method

[134] Mr. Malackowski and Dr. Leonard both treat Oracle FY 2009 as the first year of the damage period. Ideally I would calculate the But-For price per handset of Java ME in the year prior to the damage period; 2008. However, I do not have data on Java ME revenues and potential Java ME licensed handsets for 2008. Mr. Malackowski and Dr. Leonard use Oracle Fiscal Years in their lost profits analyses. Oracle Fiscal Years end May 31. Thus, FY 2009 begins June 1, 2008.

[135] See Exhibit 6.

of discounting estimated annual lost profits back to the beginning of the damage period, to arrive at a certainty equivalent at the "date of injury."[136] I then bring this certainty equivalent value forward at the risk free rate of interest to a present value as of the end of Oracle Fiscal Year 2015.[137] This results in a lost profits total of $87,049,978.[138]

# 10. Other Issues

## 10.1. Leonard's App Introduction Lag Analysis

99. Dr. Leonard's "application launch date lag" analysis relies on data for the most popular apps for iOS and Android. I do not believe that this analysis is helpful, largely because, like Dr. Leonard's other analyses that focuses on a relatively small number of most successful apps, it does not address Oracle's claim that the 37 Java APIs were important, in large part, because they enabled lots of developers to write lots of apps, particularly in the period immediately after the launch of Android.

## 10.2. Apportionment

100. Both Mr. Malackowski and Dr. Leonard employ an "apportionment" in (at least some) of their disgorgement analyses.[139] The general purpose of these apportionments is to separate all Google or Android-related profits into those that are due to the use of the 37 Java APIs from those profits that are due to other parts of Android and/or other parts of Google. As I discuss above, my preferred approach is to compare the actual (with infringement)

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[136] This calculation is performed using the Sun/Oracle Yearly Weighted Average Cost of Capital from Bloomberg.

[137] Oracle Fiscal Years end May 31. This calculation is performed using the 10-year US Treasury Bill rate.

[138] See Exhibit 6.

[139] See Exhibit 7 comparing Dr. Leonard and Mr. Malackowski's apportionment calculations. Dr. Leonard further apportions these Android profits and, additionally, Android-related profits by lines of code in his Exhibit 3e, "Top Down Apportionment".

Android profits to the But-For (without infringement) profits of Android. This exercise explicitly separates the profits due to the infringement, and thus no further apportionment is necessary. Therefore, I do not find either Mr. Malackowski's or Dr. Leonard's apportionment analyses particularly helpful, and I do not offer any explicit "apportionment" analyses.

101. Mr. Malackowski's apportionment factor and analysis approximate the results of my But-For analysis, under the assumption that the next best non-infringing alternative to Android was for Google not to develop a mobile device platform at all. Thus, I do not so much disagree with his conclusion (the disgorgement amount) as I do with his method of getting to that amount. Mr. Malackowski only apportions the total Google Android-related profits between Android (or, between any mobile OS) and the other Google assets (including Google Search ad technologies, the Google brand, etc.). He does not apportion between the infringed APIs and rest of Android. This is fine if, as Mr. Malackowski concludes, the 37 Java APIs are essential for the success of Android. However, if the jury concludes that Android could have been successfully launched (even though it may have had a lower market share), then Mr. Malackowski's apportionment approach is incorrect.

102. I do not find Dr. Leonard's apportionment analyses based on lines of code to be useful. As Dr. Leonard notes, this approach is based on an assumption that the lines of code associated with the 37 Java APIs are no more important that the other lines of code in Android (or, in one of his apportionment analyses, of other lines of code in Android and Google search ad technologies). If this is correct, that there is nothing special about the 37 Java APIs, then the value of these APIs (over, other APIs or APIs structures that Google could have used) is zero. If the value of these APIs is zero, then there is nothing to apportion. Thus, if the jury were to conclude that the use of the 37 Java APIs in Android did not offer

any advantage to Google, I would recommend a disgorgement award of $0, and not the amounts of [redacted] offered by Dr. Leonard.[140]

103. In the event that the jury concludes the use of the 37 Java APIs was not essential to Android, but did increase the market success of Android, the apportionment task becomes more difficult. But if the jury concludes that the effect is fully measured by a decrease in market share then as noted above, the numbers range between $2.08 billion and $3.51 billion.

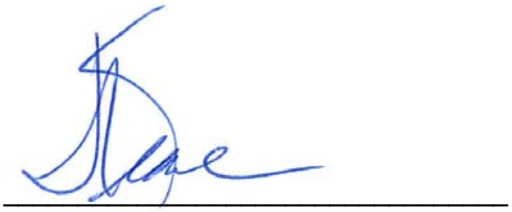
### 10.3. The 2006 Sun/Google Negotiation

104. In the previous phase of this litigation, the damages analyses focused heavily on the licensing negotiations between Sun and Google. In this current phase of the litigation these negotiations have barely been mentioned. I understand that Oracle is not seeking as a damages remedy a lost license fee. Therefore, the amount Sun would have been willing to accept to license the subject copyrights to Google may be irrelevant. However, it is notable that the amounts of damages at play now (under some non-infringing alternative scenarios) are large relative to the amount that Sun was apparently willing to accept to license all Java intellectual property.

105. I also note that the approaches taken by the experts in this current phase of litigation are different from the first round of expert analysis made in the previous round of Oracle v. Google litigation addressed in my 2012 report. As such, this report addresses only the current approaches put forth by Dr. Leonard, Mr. Malackowski and Professor Jaffe.

[140] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3e.

Respectfully submitted this 21st day of March, 2016



J.R. Kearl

# Appendix A: Curriculum Vita

**J.R. Kearl**
Senior Consultant

Post Doctoral Economics and Law
Harvard University

PhD, Economics
Massachusetts Institute of Technology

BA, Mathematics and Economics
Utah State University

Dr. James R. Kearl is a senior consultant to CRA with the Antitrust & Competition Economics Practice and the A.O. Smoot Professor of Economics at Brigham Young University. He specializes in applied microeconomics, industrial organization, and public policy. His areas of expertise include the economics of antitrust liability and damages, the economics of intellectual property and intellectual property damages, and general commercial damages. While a White House fellow, he served as a special assistant to the US Secretary of Defense. He has also served on the US Census Advisory Committee on Population Statistics. He has testified numerous times on antitrust, intellectual property, and complex commercial matters in state and federal courts, before the FTC, and in FINRA and JAMS arbitrations.

## Professional experience

| | |
|---|---|
| 2000–Present | Senior Consultant, Charles River Associates |
| 1996–Present | A.O. Smoot Professor of Economics, Brigham Young University |
| 1991–Present | Assistant to the President for the Jerusalem Center for Near Eastern Studies, Brigham Young University |
| 1996–2000 | Director and Senior Economist, LECG, Inc. |
| 1993–1996 | Chair, University Strategic Planning Initiative and Reaccreditation Self-Study, Brigham Young University |
| 1989–1991 | Associate Academic Vice President, Brigham Young University |
| 1986–1997 | Professor, Economics, Brigham Young University |
| 1986–1989 | Dean of General and Honors Education, Brigham Young University |
| 1984–1986 | Professor, Economics and Law, Brigham Young University |
| 1984 | Special Assistant, United States Trade Representative |
| 1983–1984 | Special Assistant, U.S. Secretary of Defense |
| 1981–1983 | Chair, University Library Council |
| 1979–1991 | Research Associate, National Bureau of Economic Research |
| 1979–1982 | Member, University Graduate Council |
| 1978–1983 | Associate Professor, Economics and Law, Brigham Young University |
| 1975–1978 | Assistant Professor, Economics, Brigham Young University |
| 1973–1974 | Teaching Fellow, Harvard University |
| 1973 | Visiting Instructor, Brigham Young University (Summer) |
| 1971–1974 | Research Assistant, National Bureau of Economic Research |

1970–1971 Teaching Assistant, Utah State University

## Community service

Chair, Food and Care Coalition Board, 2005–2007

Member, Food and Care Coalition Executive Committee, 2003–2012

Member, Food and Care Coalition Board, 2002–2003

Member, Ouelessebougou/Utah Alliance Executive Committee, 2001

Member, Ouelessebougou/Utah Alliance Board, 1997–2000

Member, US Census Advisory Committee on Population Statistics, 1991–1994

Member, Governor's Task Force for Education and Economic Development, 1989

Member, State of Utah Task Force on Concurrent Enrollment, 1988

## Honors and fellowships

A.O. Smoot Professorship in Economics, 1996–Present

Maeser Distinguished Teaching Award, 1992

White House Fellow, 1983–1984

Liberal Arts Fellow in Law and Economics, Harvard University, 1977–1978

Fellow, Legal Institute for Economists, 1977

SSRC Postdoctoral Award, 1975

Danforth Graduate Fellow, 1971–1975

BA, magna cum laude, 1971

Elected Blue Key, 1970

Elected Phi Kappa Phi, 1970

First Security Foundation Scholarship, 1970

## Publications

### *Books*

*Economics and Public Policy: An Analytical Approach, 6th Edition* (Pearson, 2010).

*Principles of Economics,* (D. C. Heath, 1993)

*Contemporary Economics: Markets and Public Policy,* (Scott Foresman, 1989)

### *Book or Monograph Chapters*

"Financial Determinants of Housing Demand," in *New Mortgage Designs for Stable Housing in an Inflationary Environment*, (with C. Swan and K. Rosen), F. Modigliani, editor (Federal Reserve Bank of Boston, Conference Series No. 14, 1976)

"Macroeconomic Simulations of Alternative Mortgage Instruments," in *New Mortgage Designs for*

*Stable Housing in an Inflationary Environment*, (with D. Jaffee), F. Modigliani, editor (Boston, Mass.: Federal Reserve Bank of Boston, Conference Series No. 14, 1976)

"The Housing Market and Alternative Mortgage Instruments," in *Alternative Mortgage Instruments*, Vol. III, D. Kaplan, Editor, (FHLBB, November 1977)

"Choices, Rents and the Economic Mobility of Households," (with C. Pope), *NBER Studies in Income and Wealth* (University of Chicago Press, 1986)

"Aggregate Production Functions," (with F. Fisher and R. Solow), *Aggregation: Aggregate Production Functions and Related Topics* (MIT Press, 1993)

### *Journal Articles*

"Aggregate Production Functions: Some CES Experiments," (with F. Fisher and R. Solow), *Review of Economic Studies*, June 1977

"Do Entitlements Imply that Taxation is Theft?" *Philosophy and Public Affairs*, Fall 1977

"Illiquidity, the Demand for Residential Housing and Monetary Policy," (with F. Mishkin), *Journal of Finance*, December 1977

"Legal Impediments to Mortgage Innovation," (with M. Hyer), Real Estate Law Review, Winter 1978

"Inflation and Relative Price Distortions: The Case of Housing," *The Review of Economics and Statistics*, November 1978

"Mortgages and Housing: The Issues and Some Evidence," *Journal of Consumer Credit Management*, Spring 1979

"A Confusion of Economists?" (with C. Pope, G. Whiting and L. Wimmer), *American Economic Review*, May 1979 (reprinted in the Kindai Keizagaku Series, October 1979)

"Inflation, Mortgages and Housing," *Journal of Political Economy*, September 1979

"Piecemeal De-Regulation: The Problems of Deposit Interest Rate Regulation and Mortgage Innovation," *Journal of Economics and Business*, Fall 1980

"Household Wealth in Utah: 1850-1870," (with C. Pope), *Journal of Economic History*, September 1980

"Deposit Rate Ceiling De-Regulation and Mortgage Innovation," *Empirical Economics*, Vol. 5, 1980

"Wealth Mobility: The Missing Element," (with C. Pope), *Journal of Interdisciplinary History*, March 1983

"The Life Cycle in Economic History," (with C. Pope), Journal of Economic History, March 1983

"Rules, Rule Intermediaries and the Complexity and Stability of Regulation," *Journal of Public Economics*, 1984

"Mobility and Distribution," (with C. Pope), *Review of Economics and Statistics*, 1984

"Unobservable Family and Individual Contributions to the Distributions of Income and Wealth," (with C. Pope), *Journal of Labor Economics*, July 1986

"Economics and Antitrust Litigation," (with S. Wood), *The American Journal of Comparative Law*, 34, Summer 1986

"The Covariance Structure of Earnings and Income, Compensation Behavior, and On-the-Job Investment," *Review of Economics and Statistics*, May 1988

"Is There a Consensus Among Economists in the 1990s?" (with R. Alston and M. Vaughan), *American Economic Review*, May 1992

"The Economics and Curious Law of Prejudgment Interest" (with M. Glick and C. Sinclair), *University of Utah Law Review*, January 2011

## Professional activities

### *Presentations at professional meetings and workshops*

"Antitrust Issues for Transactional Lawyers," Utah Bar Association and CLE Workshop, Sun Valley, July 2012

"Antitrust Law and the Economics of Bundled Prices," Utah Bar Association and CLE Workshop, San Diego, July 2011 (with G. Adams)

"Antitrust Law and the Economics of Aftermarket Monopolization," Utah Bar Association and CLE Workshop, San Diego, July 2011 (with G. Adams)

"Working with Damages Experts in Light of Recent Changes in the Federal Rules," CLE Workshop, Provo, August 2011

"Expert Depositions," Utah Bar Association, Salt Lake City, November 2010

"Working with Economic Expert Witnesses," CLE Workshop, Provo, August 2009

"The Economic Approach to Law," CLE Workshop, Provo, August 2008.

"Valuing IP: An Economic Perspective," CLE Workshop, San Diego, Jan. 2004.

"Valuing IP: An Economic Perspective," CLE Workshop, Seattle, July 2003.

"Causality and Damages: An Economic Perspective," CLE Workshop, Phoenix, March 2003.

### *Lectureships*

Visiting Faculty, Professional Training Institute, Republic of China, Summers 1986-1996

USIA Lectureships (various locations in Europe and Asia), Summers, 1986-1996

*Referee*

*American Economic Review*

*AREUEA Journal*

*Econometrica*

*Journal of Economic Dynamics and Control*

*Journal of Human Resources*

*Journal of Law and Economics*

*Journal of Money, Credit and Banking*

*Journal of Public Economics*

*Management Science*

*Quarterly Journal of Economics*

*Review of Economics and Statistics*

*Review of Economic Studies*

*Southern Economic Journal*

*Economic Inquiry*

*Reviews (selected)*

*National Science Foundation*

*Economic Expert (selected)*

- Patent damages, desk top products, 2015-Present
- Copyright damages, specialized operating systems, 2015-Present
- Trade secret and business tort damages, real estate valuation software, 2015-Present
- Patent damages, computer security software and devices, 2015-Present
- Patent damages, FPGA products, 2015-Present
- Antitrust liability and damages, steel construction products, 2014-Present
- Antitrust liability and damages, specialized steel products, 2014-Present
- Patent damages, video casting, 2014-Present
- Patent damages and preliminary injunction, protein separation devices, 2014-Present
- Commerce Clause litigation, local retail pet dealers, 2014-Present
- Patent damages, computer security devices, 2014-Present
- Patent damages, computer random number generators, 2014
- Patent damages, consumer electronic devices, 2014-Present
- Patent damages, telecommunications services, 2014-Present
- Patent damages, video projection devices, 2014-Present
- Non-compete contract damages, computer security devices, 2014
- Patent damages, genetic tests, 2013-Present
- Legal malpractice damages, 2013-Present

- Antitrust liability and damages (patent misuse), flash memory, 2013-14
- Patent damages, mobile devices, 2013–2014
- Patent damages, semiconductors and micro devices, 2013–2014
- Patent damages, computer and internet security software, 2013–Present
- Antitrust liability and damages (class certification), trucking, 2013–Present
- Contract damages, medical implant devices and patents, 2012–2014
- Patent damages, home lighting and environment controls and devices, 2011–2013
- Rule 706 patent and copyright damages expert, software, 2011–Present
- Patent damages, gaming devices, 2011–2012
- Contract damages, internet business, 2011–2014
- Antitrust liability and damages, truck stops, 2010–Present
- Condemnation damages, construction supply industry, 2010
- Arbitration damages in re auction rate securities, 2010–2012
- Non-compete contract and tortuous interference damages, construction industry, 2010–2012
- Patent damages, retail computer products, 2010–2011
- Antitrust liability and damages, aftermarket software and hardware products, 2010
- Damages, delayed insurance payments, 2010
- Contract damages, microchip manufacturing devices and patents, 2007–2008
- Antitrust liability and damages, medical supply Group Purchasing Organizations, 2009–2010
- Damages, real estate contract dispute, 2009–2010
- Antitrust liability and damages, dialysis clinics, 2009–2010
- Merger analysis, hospitals, 2008–2009
- Damages, online auctions, 2008–2010
- Contract damages, failed software implementation, 2008–2009
- Non-compete contract and tortuous interference damages, insurance industry, 2007-2009
- Patent damages, gaming devices, 2007
- Antitrust liability, chemicals, 2007
- Antitrust liability and damages, golf scheduling, 2006-2007
- Damages, software market compensation and valuation, 2007–2009
- Patent and trade dress damages, dental products, 2006-07
- Arbitration damages in re stock analyst, 2006 – 2007

*Courses taught*

Principles of Economics
Principles of Economics, Honors
Principles of Economics, Independent Study
Applied Microeconomics
Advanced Applied Microeconomics

Applied Econometrics
Applied Welfare Economics
Law and Economics
Law and Economics for Law Students
Antitrust and Monopoly Regulation
International Trade Theory
International Trade Policy
Seminar on Distribution and Mobility
Seminar on Applied Microeconomics

*Joint or team taught courses*

Seminar on the Economics of Family (with C. Pope and G. Becker)
Honors Colloquium: Modeling Human Behavior (with S. Condie, H. Miller, M. Myers)
Antitrust Law (with R. Lee, then D. Floyd)
Administrative Law (with S. Wood)
International Trade Law (with S. Wood)
Seminar on the History of Jerusalem (with K. Belnap)

# Appendix B: Past Testimony

Layton Construction Co. v. SIRQ, Inc.
Third Judicial District Court; Salt Lake County, State of Utah
Civil No. 070908853; Civil No. 070912813 (consolidated cases)
Client: Layton Construction Co.
Deposition August 2011
Trial Testimony January 2013

Oracle America, Inc. v. Google, Inc.
United States District Court; Northern District of California, San Francisco Division
Case No. 3:10-CV-03561-WHA
Client: Rule 706 Court Expert
Deposition March 2012

ClearOne Communications, Inc. v. Morgan Stanley & Co., Inc.
Financial Industry Regulatory Authority
FINRA-DR Case No. 09-06769
Client: Morgan Stanley & Co., Inc.
FINRA Arbitration Testimony October 2012

Lutron Electronics Co, Inc. v. Crestron Electronics, Inc. et al.
United States District Court; District of Utah, Central Division
Case: 2:09-CV-707
Client: Crestron Electronics, Inc.
Deposition October 2012
Trial Testimony October 2013
Deposition October 2013

John Braun, MD et al v. Medtronic Sofamor Danek Inc. and SDGI Holdings, Inc.
United States District Court; District of Utah, Central Division
Civil No. 2:10-CV-001283-DBP
Client: Medtronic Sofamor Danek, Inc.
Deposition July 2013
Trial Testimony February 2014

Network Protection Sciences, LLC. v. Fortinet, Inc.
United States District Court; Northern District of California
Civil No. 3:12-CV-01106-WHA
Client: Fortinet, Inc.
Deposition August 2013

Apple Inc. v. Samsung Electronics Co. Ltd et al.
United States District Court; Northern District of California
Case No. 12-CV-00630-LHK
Client: Samsung Electronics Co. Ltd
Deposition October 2013
Trial Testimony April 2014

Symantec Corporation v. Acronis Inc. et al.
United States District Court; Northern District of California
Case No. 3:11-cv-05310 EMC
Client: Symantec Corporation
Deposition October 2013

Fortinet, Inc. v. Michael Valentine and Jason Clark
JAMS Arbitration REF# 1110016639; REF# 1110016737
In re United States District Court; Northern District of California
Case Nos. 13-cv-05831-EMC (N.D. Cal)
Client: Fortinet, Inc.
Deposition November 2014
Testimony November 2014

GE Healthcare Bio-Sciences AB, GE Healthcare Bio-Sciences Corporation and General Electric Company v. Bio-Rad Laboratories, Inc.
United States District Court for the Southern District of New York
Case No. 14-CV-7080-LTS
Client: Bio-Rad Laboratories, Inc.
Deposition December 2014
Testimony June 2015

Estate of Wallace R Woodbury v. Callister Nebeker & McCullough
Third Judicial District Court Salt Lake County, State of Utah
Case No. 130900897
Client: Woodbury Estate
Deposition December 2014
Deposition June 2015

Puppies 'N Love v. City of Phoenix
United States District Court, District of Arizona
Case No. 2:14-CV-00073-PHX-DGC
Client: Puppies 'N Love
Deposition January 2015

California Institute of Technology v. Hughes Communications, Inc. et al.
United States District Court, Central District of California
Case No. 2:13-CV-7245 MRP (JEM)
Client: California Institute of Technology
Deposition February 2015

ClarkDietrich v. Certified Steel Stud Association, et al.
Court of Common Pleas, Butler County, Ohio
Case No. CV 2013 10 2809 (Consolidated from CV 2013 10 3027)
Client: ClarkDietrich
Deposition March 2015

Altera Corporation v. PACT XPP Technologies, AG
United States District Court; Northern District of California
Case No. 3:14-cv-02868-JD
Client: PACT XPP Technologies, AG
Deposition September 2015

Aylus Networks, Inc. v. Apple, Inc.
United States District Court; Northern District of California
Case No. 3:13-cv-04700-EMC
Client: Aylus Networks, Inc.
Deposition September 2015

Fortinet, Inc. v. Sophos, Inc., Michael Valentine, and Jason Clark

United States District Court; Northern District of California
Case Nos. 13-cv-05831-EMC (N.D. Cal), 14-cv-0100-GMS (D. Del)
Client: Fortinet, Inc.
Deposition September 2015

MC Oil and Gas, LLC. v. Ultra Resources, et al.
United States District Court; District of Utah, Northern Division
Case No. 1:15-CV-00038
Client: Ultra Resources, et al.
Deposition October 2015

# Appendix C: Materials Relied Upon

## Legal Filings

01. 2011.01.06 [Oracle] Resp to Google 1st RFP (1-65).pdf

01. 2011.01.06 [Oracle] Resp to Google 1st Rogs (1-10) w Exs.pdf

01. 2011.08.04 [Oracle] Resp and Obj to Google 1st RFAs (1-429).pdf

02. 2011.01.25 [Oracle] 1st Supp Resp and Obj to Google 1st RFP (1-65).pdf

02. 2011.02.25 [Oracle] Resp to Google 2nd Rogs (11-12).pdf

02. 2015.11.30 [Oracle] Resps and Objs to Google 2nd RFAs (430-471).pdf

03. 2011.03.30 [Oracle] Resp to Google 3rd Rogs (13).pdf

03. 2011.04.08 [Oracle] 1st Supp Resp to Google RFP (22).pdf

04. 2011.04.25 [Oracle] Supp Resp to Google Rog (13).pdf

04. 2011.08.15 [Oracle] 2nd Supp Resp to Google 1st RFP (1-65).pdf

05. 2011.04.25 [Oracle] Supp Resp to Google Rogs (1-10) [AEO].pdf

05. 2011.08.16 [Oracle] 3nd Supp Resp to Google 1st RFP (1-65).pdf

06. 2011.01.18 [Oracle] Resp to 2nd RFP (66-84).pdf

06. 2011.05.24 [Oracle] 2nd Supp Resp to Google Rog (13).pdf

07. 2011.07.14 [Oracle] Obj and Resp to Google 4th Rogs (14-17) [Conf].pdf

07. 2011.08.15 [Oracle] 1st Supp Resp to Google 2nd RPF (66-84).pdf

08. 2011.07.22 [Oracle] Resp to Google Amend Rog (15).pdf

08. 2011.08.16 [Oracle] 2nd Supp Resp to Google 2nd RFP (66-84).pdf

09. 2011.02.25 [Oracle] Resp to 3rd RFP (85-90).pdf

09. 2011.07.28 [Oracle] Resp to Google 5th Rogs (18-20).pdf

10-03561_#1454-motion.zip

10-03561_#1474-letter brief.zip

10-03561_#1477.pdf

10. 2011.07.29 [Oracle] Supp Resp to Google Rogs (1-10) [AEO].pdf

10. 2011.08.15 [Oracle] Supp Resp to Google 3rd RFP (85-90).pdf

11. 2011.08.01 [Oracle] 3rd Supp Resp to Google Rogs (13).pdf

11. 2011.08.16 [Oracle] 2nd Supp Resp to Google 3rd RFP (85-90).pdf

12. 2011.05.02 [Oracle] Resp and Obj to Google 4th RFP (91-94).pdf

12. 2011.08.01 [Oracle] Supp Resp to Google 5th Rogs (18-20).pdf

13. 2011.05.25 [Oracle] Supp Resp to Google 4th RFP (91-94).pdf

13. 2015.09.17 [Oracle] Obj to Google 6th Rogs (21-33).pdf

14. 2011.08.15 [Oracle] 2nd Supp Resp to Google 4th RFPs (91-94).pdf

14. 2015.10.05 [Oracle] Obj and Resp to Google 6th Rogs (21-33).pdf

15. 2011.07.14 [Oracle] Obj and Resp to Google 5th RFP (95-101).pdf

15. 2015.11.12 [Oracle] Supp Resp and Obj to Google 6th Rogs (21-33).pdf

16. 2011.08.15 [Oracle] Supp Resp to Google 5th RFP (95-101).pdf

16. 2015.11.30 [Oracle] Resps and Objs to Google Rogs Set 7 (34-37) [AEO].pdf

17. 2011.07.28 [Oracle] Resp to Google 6th RFP (102-129).pdf

18. 2011.08.15 [Oracle] Supp Resp to Google 6th RFP (102-129).pdf

19. 2011.08.16 [Oracle] 2nd Supp Resp to Google 6th RFP (102-129).pdf

20. 2015.09.17 [Oracle] Objs to Google 7th RFPs (130-182).pdf

2011.01.06 Google's Resp to ORACLE 1st RFPs (Nos. 1-81) (Part 1).pdf

2011.01.06 Google's Resp to ORACLE 1st RFPs (Nos. 1-81) (Part 2) -Doc Sources.pdf

2011.01.06 Google's Resp to ORACLE 1st ROGS (Nos. 1-16).pdf

2011.02.04 Google's 1st Supp Resp to Oracle 1st ROGS (Nos. 1 and 3).pdf

2011.02.04 Google's 1st Suppl Resp to ORACLE 1st RFPs (Nos. 1-81).pdf

2011.02.18 Google's 2nd Supp Resp to Oracle 1st ROGS (No. 3).pdf

2011.02.28 Google's Resp to ORACLE 2d RFPs (Nos. 82-130).pdf

2011.03.10 Google's Resp to ORACLE 3d RFPs (Nos. 131-152).pdf

2011.03.10 [Oracle] 30(b)(6) Depo Ntc of Google.pdf

2011.03.14 Google's 30(b)(6) Deposition Notice to - ORACLE.pdf

2011.04.01 Google's 3d Suppl Resp to Oracle's 1st Set of ROG (No. 3).pdf

2011.04.01 [Oracle] 30(b)(6) Ntc of Google - Topic 3.pdf

2011.04.12 Google's 1st Suppl Resp to ORACLE 2d RFPs (Nos. 82-130).pdf

2011.04.12 Google's 2d Suppl Resp to ORACLE 1st RFPs (Nos. 1-81).pdf

2011.04.14 Google's Resp to 2nd Set of ROG (No. 17).pdf

2011.04.14 Google's Resp to ORACLE 4th RFP (Nos. 153-160).pdf

2011.04.25 Google's 3rd Supp Response to Oracle's 1st Set of ROGS (Nos. 4-16).pdf

2011.04.27 Google's 4th Supp Resp to Oracle's 1st Set of ROGS (No. 3).pdf

2011.05.02 Google's Supp Resp to 2nd Set of ROGS (No. 17).pdf

2011.05.09 Google's 2nd 30(b)(6) Depo Notice to ORACLE.pdf

2011.05.23 Google's Resp to ORACLE 5th RFPs (Nos. 161-167).pdf

2011.05.23 Google's Resp to Oracle's 3d Set ROGS (Nos. 18-19).pdf

2011.06.01 Google's 2nd Suppl Resp to 2nd Set of ROGS (No. 17).pdf

2011.06.06 Google's Resp to ORACLE Set 6 RFP (Nos. 168-174).pdf

2011.06.21 Google's 2nd (3rd)30(b)(6) Deposition Notice to ORACLE.pdf

2011.06.21 [Oracle] 30(b)(6) Depo Ntc of Google - Topics 4-9.pdf

2011.06.27 Google Resp to Oracle's 7th RFPs (No. 175).pdf

2011.07.06 Errata to Google's Notice of Rule 30B6 Depo to Oracle on 6-21-11.pdf

2011.07.08 Google's 4th 30(b)(6) Depo Notice to Oracle.pdf

2011.07.09 Google's 4th 30(b)(6) Depo Notice to Oracle - CORRECTED.pdf

2011.07.10 Google's 4th Rule 30(b)(6) Notice to Oracle (2nd corrected).pdf

2011.07.13 [Oracle] 30(b)(6) Ntc to Google - Topics 10-13.pdf

2011.07.18 Google's 5th Notice of 30(b)(6) Notice to Oracle.pdf

2011.07.26 Google's 4th Supp Resp to ORACLE ROG set 1 (No. 3).pdf

2011.07.29 Google's Resp to ORACLE 4th ROGs (Nos. 20-25).pdf

2011.07.29 Google's Resp to ORACLE 8th RFPs (Nos 176-204).pdf

2011.07.29 Google's Suppl Response to ORACLE 3rd ROGs (No. 18).pdf

2011.08 01 Google's Suppl Resp to ORACLE 1st ROGs (No. 2).pdf

2011.08.01 Google's 3rd Suppl Resp to ORACLE 2nd ROGs (No. 17).pdf

2011.08.01 Google's 5th Suppl Resp to ORACLE 1st ROGs (No. 3).pdf

2011.08.04 Google Resp to Oracle's 1st set of RFAs (1-244).pdf

2011.08.15 Google's 1st Suppl Responses to 3rd ORACLE RFPs (Nos. 131-152).pdf

2011.08.15 Google's 1st Suppl Responses to 4th ORACLE RFPs (Nos. 153-160).pdf

2011.08.15 Google's 1st Suppl Responses to 5th ORACLE RFPs (Nos. 161-167).pdf

2011.08.15 Google's 1st Suppl Responses to 6th ORACLE RFPs (Nos. 168-174).pdf

2011.08.15 Google's 1st Suppl Responses to 8th ORACLE RFPs (Nos. 176-204).pdf

2011.08.15 Google's 2nd Suppl Responses to 2nd ORACLE RFPs (Nos. 82-130).pdf

2011.08.15 Google's 3rd Suppl Responses to 1st ORACLE RFPs (Nos. 1-81).pdf

2012-06-05 Order Dr. Kearl fully paid prior to 6-21-

12.pdf

2015-10-26 Order re Damage Studies (1349).PDF

2015-11-09 Google Response to Court_s October 26, 2015 Order re Damage S....pdf

2015-11-09 UNREDACTED Oracle Response to Order re Damages Studies.pdf

2015-11-23 Order denying Oracle's motion to disqualify Dr. Kearl.pdf

2015-11-24 Order to clarify duties of 706 Expert.pdf

2015-12-09 Order Clarifying Duties of Rule 706 Expert--changes highlighted.pdf

2015-12-09 Order Clarifying Duties of Rule 706 Expert.pdf

2015.08.12 (1292) [Oracle] Supplemental Complaint.pdf

2015.09.05 Google's Objections to Oracle's Interrogatories, Set Five (Nos. 26-37).pdf

2015.09.15 Google's Objections_to Oracle's 2nd Set of RFAs (Nos. 245-277).pdf

2015.09.18 (1321) [Court] ORDER re Willfulness and Bifurcation.pdf

2015.09.21 Google Responses to Oracle's 5th Set of ROGs (Nos. 26-37).pdf

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**Exhibit 1. Comparison of Mr. Malackowski's and Dr. Leonard's Estimates of Android Traffic Acquisition Costs (TAC)**
*(in millions)*

| | TAC from Android P&Ls (2008-2010) | | | | | | Estimated TAC Using Overall Google TAC and Revenue Reports (2011-2014) | | | | | | | | | | | Annualized 2015 Estimation | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | Total (2011-2014) | | | 2015 | | 2011-2015 | | |
| | M | L | M | L | M | L | M | L | M | L | M | L | M | L | M | L | Diff. (L - M) | M | L | M | L | Diff. (L - M) |
| **Android Search TAC Estimation** | | | | | | | | | | | | | | | | | | | | | | |
| Google Total AdWords Revenue | | | | | | | - | $25,028 | - | $29,527 | | | | | | | | | | | | |
| Google Total AdWords TAC | | | | | | | - | 1,333 | - | 1,864 | | | | | | | | | | | | |
| Google Total AdWords (% of Total AdWords Revenue) | | | | | | | - | 5% | - | 6% | | | | | | | | | | | | |
| Android Search Revenues | | | | | | | - | 438 | - | 1,445 | | | | | | | | | | | | |
| Android Search TAC | | | | | | | 0 | 23 | 0 | 91 | | | | | | | | | | | | |
| **Android AdSense TAC Estimation** | | | | | | | | | | | | | | | | | | | | | | |
| Google Total AFS Revenue | | | | | | | $5,000 | $5,000 | $6,124 | $6,124 | | | | | | | | | | | | |
| Google Total AFS TAC | | | | | | | 3,534 | 3,534 | 4,352 | 4,352 | | | | | | | | | | | | |
| Google Total AFS TAC (% of Total AFS Revenue) | | | | | | | 71% | 71% | 71% | 71% | | | | | | | | | | | | |
| Android AdSense Revenues | | | | | | | 43 | 43 | 239 | 239 | | | | | | | | | | | | |
| Android AdSense TAC | | | | | | | 31 | 31 | 170 | 170 | | | | | | | | | | | | |
| **Android Display TAC Estimation** | | | | | | | | | | | | | | | | | | | | | | |
| Google Total Display Revenue | | | | | | | $5,277 | $5,277 | $6,237 | $6,237 | | | | | | | | | | | | |
| Google Total Display TAC | | | | | | | 3,252 | 3,252 | 3,870 | 3,870 | | | | | | | | | | | | |
| Google Total Display TAC (% of Total Display Revenue) | | | | | | | 62% | 62% | 62% | 62% | | | | | | | | | | | | |
| Android Display Revenues | | | | | | | 88 | 88 | 469 | 469 | | | | | | | | | | | | |
| Android Display TAC | | | | | | | 54 | 54 | 291 | 291 | | | | | | | | | | | | |
| **Android Total TAC** | $0 | $0 | $3 | $3 | $41 | $41 | $85 | $108 | $460 | $552 | | | | | | | | | | | | |
| **Android Ad Revenue** | 1 | 1 | 16 | 16 | 120 | 120 | 569 | 569 | 2,152 | 2,152 | | | | | | | | | | | | |
| **Android Total TAC (% of Android Ad Revenue)** | 29% | 29% | 18% | 18% | 34% | 34% | 15% | 19% | 21% | 26% | | | | | | | | | | | | |

[redacted]

Total (2011-2014)

Total (2008-2015)

**Sources:**

[1] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibits 7, 7.2, 7.3, 7.5

[2] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 1a.1, 1c, 1d

**Notes:**

[a] Malackowski did not include an estimate of Android Search TAC, as he believes this is already counted in the "Apps" and "Digital Content" cost line items in Malackowski's Revised Exhibit 7.

[b] To estimate 2015 Android TAC, Leonard takes the ratio of 2014 Total Android TAC (Search, AdSense, and Display) to 2014 Total Android Revenue (Search, AdSense, and Display) and applies it to 2015 Total Android Revenue (Search, AdSense, and Display), which is annualized based on 2015 Q1 and Q2. This adjustment is reported here for each TAC group, Search, AdSense, and Display.

[c] To estimate 2015 Android TACs, Malackowski uses the 2014 TAC to Revenue ratios for AdSense and Display and applies them to the 2015 Android revenues for AdSense and Display, respectively, which are annualized based on 2015 Q1 and Q2.

**Exhibit 2. Comparison of Mr. Malackowski's and Dr. Leonard's Estimates of Android Profits**
***(in millions)***

| | Malackowski 2008-2015 | Leonard 2008-2015 | Difference |
|---|---|---|---|
| | | | [3] |
| **Android Revenue** | | | |
| Ads | | | $ - |
| Hardware | | | - |
| App downloads from Google Play | | | - |
| Digital Content sales through Google Play | | | - |
| | | | - |
| **Android Costs** | | | |
| TAC | | | 1,749.2 |
| Hardware | | | (109.9) |
| Apps | | | - |
| Digital Content | | | - |
| Infrastructure and other COS | | | (5.3) |
| Operations | | | [redacted] |
| COS (including DTC, "Direct-to-Consumer") | | | [redacted] |
| | | | 1,749.2 |
| **Android Gross Profit** | | | |
| Total Gross Profit | | | (1,749.2) |
| Gross Margin | | | -4.3% |
| **Android Direct Operating Expenses** | | | |
| Android Engineering PM | | | - |
| Android Marketing | | | (0.1) |
| Android Legal | | | - |
| Android Sales and Other | | | - |
| Android General and Administrative | | | [redacted] |
| Incremental Search and Advertising Expenses | | | [redacted] |
| | | | 3,891.4 |
| **Android Profit** | | | $ (5,640.6) |

**Sources:**

[1] Responsive Expert Report of James E. Malackowski (Corrected), February 29, 2016, Revised Exhibit 7.

[2] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1a.1.

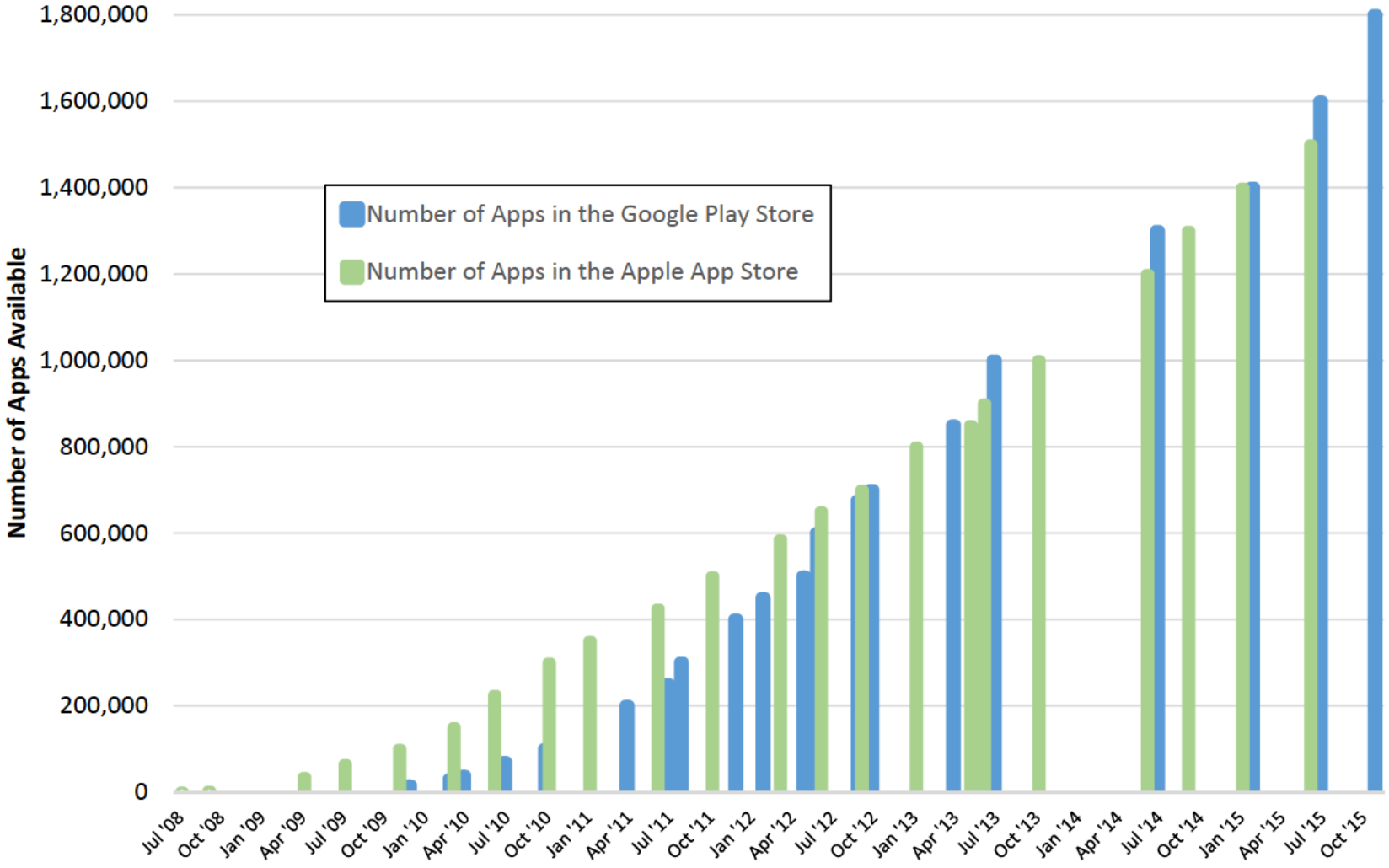
[3] = [2]- [1]

**Notes:**

[a] The discrepancies arising in rows: Hardware, Infrastructure and other COS, Operations, COS, and Android Marketing appear to be differences between how Dr. Leonard and Mr. Malackowski categorize those costs, not differences of opinion in the amounts or whether the costs should be included. This is confirmed in the Responsive Expert Report James E. Malackowski (Corrected), February 29, 2016, para. 64: "In fact, only the following three cost/expense line items are different: 1) Traffic Acquisition Costs (a cost of sale), 2) “Android General and Administrative Expense” (an operating expense), and 3) “Incremental Search and Advertising Expense” (an operating expense)." There may be minor differences in the costs of Apps and Digital Content, but those differences appear to be due to presentation and rounding, not substantive disagreements.

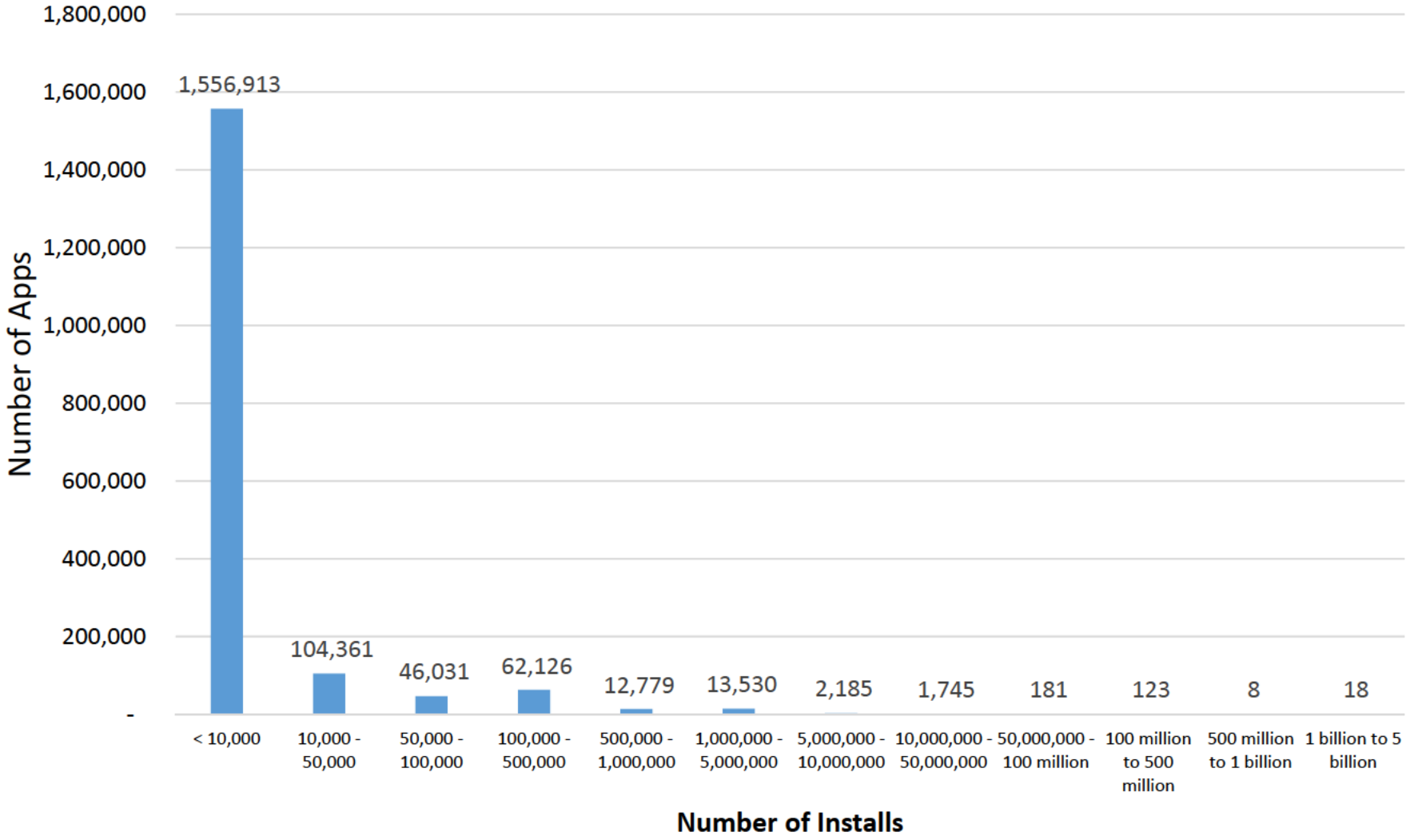
[b] I adopt the cost estimates put forth by Dr. Leonard, as discussed in my report.

## Exhibit 3a. Number of Apps Available in the Google Play and Apple App Stores 2008-2015




Sources: http://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/
http://www.statista.com/statistics/263795/number-of-available-apps-in-the-apple-app-store/

## Exhibit 3b. Download Distribution of Android Apps as of March 18, 2016




Sources: Retrieved from http://www.androidrank.org/categorystats?category=&price=all&hl=en as of March 18, 2016.
http://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store

**Exhibit 4a.1 (Corrected)**
**Summary of Sensitivity and Counterfactual Tests on Kim Model:**
**Available Applications, Changes in Handset Sales, and Net Loss Profit**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Apps Available** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | | | | | 751 | 762 | 1,125 | 1,175 | **2,687** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [a] Scenario 1 | | | | | 751 | 761 | 1,124 | 1,175 | **2,686** |
| [b] Scenario 2 | | | | | 525 | 581 | 822 | 854 | **1,814** |
| [c] Scenario 3 | | | | | 177 | 202 | 170 | 127 | **344** |
| Actual | | | | | 1,108 | 967 | 1,356 | 1,512 | **3,642** |
| **Changes in Handset Sales (*in thousands of units*)** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | | | | | | | | | |
| Android Devices | -18.2 | -168.2 | -1,512.2 | -4,797.8 | -9,412.4 | -8,657.2 | -12,545.3 | -8,173.4 | **-45,284.8** |
| iOS Devices | 10.0 | 83.2 | 648.4 | 1,876.0 | 3,466.2 | 2,636.0 | 3,822.1 | 2,614.7 | **15,156.6** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [a] Scenario 1 | | | | | | | | | |
| Android Devices | -18.2 | -168.2 | -1,512.2 | -4,797.8 | -9,412.4 | -8,657.8 | -12,545.5 | -8,173.4 | **-45,285.5** |
| iOS Devices | 10.0 | 83.2 | 648.4 | 1,876.0 | 3,466.2 | 2,636.2 | 3,822.1 | 2,614.7 | **15,156.8** |
| [b] Scenario 2 | | | | | | | | | |
| Android Devices | -72.9 | -676.7 | -6,122.5 | -19,510.6 | -38,390.7 | -42,714.7 | -53,910.0 | -41,381.9 | **-202,780.0** |
| iOS Devices | 41.0 | 342.6 | 2,700.8 | 7,877.8 | 14,637.6 | 13,455.1 | 16,947.1 | 13,647.5 | **69,649.5** |
| [c] Scenario 3 | | | | | | | | | |
| Android Devices | -178.2 | -1,665.9 | -15,226.2 | -48,857.8 | -96,585.1 | -174,739.7 | -225,463.4 | -169,680.8 | **-732,397.2** |
| iOS Devices | 103.8 | 880.4 | 7,090.6 | 20,995.0 | 39,412.2 | 62,459.0 | 80,209.9 | 62,666.2 | **273,817.1** |
| [3] Sigma (σ) Sensitivity | | | | | | | | | |
| [d] Sigma (σ)=0.607 | | | | | | | | | |
| Android Devices | -13.2 | -125.3 | -1,166.5 | -3,790.1 | -7,554.6 | -7,287.7 | -10,392.8 | -6,823.6 | **-37,153.8** |
| iOS Devices | 5.1 | 41.9 | 326.2 | 939.9 | 1,729.6 | 1,334.2 | 1,910.6 | 1,317.7 | **7,605.3** |
| [e] Sigma (σ)=0.097 | | | | | | | | | |
| Android Devices | -39.5 | -352.6 | -3,006.6 | -9,177.1 | -17,519.2 | -14,570.8 | -21,854.3 | -13,989.5 | **-80,509.6** |
| iOS Devices | 31.4 | 263.0 | 2,075.9 | 6,045.2 | 11,205.7 | 8,310.2 | 12,419.5 | 8,258.6 | **48,609.5** |
| [4] Beta (β) Sensitivity | | | | | | | | | |
| [f] Beta (β)=0.005 | | | | | | | | | |
| Android Devices | -9.1 | -84.4 | -758.0 | -2,404.0 | -4,714.9 | -4,333.7 | -6,279.5 | -4,091.3 | **-22,674.9** |
| iOS Devices | 5.0 | 41.5 | 323.2 | 934.0 | 1,724.4 | 1,311.7 | 1,902.8 | 1,300.1 | **7,542.9** |
| [g] Beta (β)=0.015 | | | | | | | | | |
| Android Devices | -27.2 | -251.6 | -2,262.9 | -7,182.2 | -14,093.5 | -12,973.7 | -18,798.9 | -12,251.8 | **-67,841.8** |
| iOS Devices | 15.1 | 125.0 | 975.0 | 2,823.4 | 5,154.5 | 3,926.7 | 5,696.5 | 3,893.3 | **22,609.5** |
| **Net Loss Profit (in millions)** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | $ 0.0 | $ 0.2 | $ 1.1 | $ 4.9 | $ 17.0 | $ [redacted] | | | **202.6** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [b] Scenario 2 | 0.0 | 0.7 | 4.5 | 19.5 | 67.2 | | | | **932.2** |
| [c] Scenario 3 | 0.0 | 1.6 | 10.8 | 46.6 | 160.3 | | | | **3,506.5** |
| [3] Sigma (σ) Sensitivity | | | | | | | | | |
| [d] Sigma (σ)=0.607 | 0.0 | 0.2 | 1.0 | 4.6 | 16.0 | | | | **182.1** |
| [e] Sigma (σ)=0.097 | 0.0 | 0.2 | 1.6 | 6.1 | 20.6 | | | | **284.9** |
| [4] Beta (β) Sensitivity | | | | | | | | | |
| [f] Beta (β)=0.005 | 0.0 | 0.1 | 0.6 | 2.5 | 8.5 | | | | **101.8** |
| [g] Beta (β)=0.015 | 0.0 | 0.2 | 1.7 | 7.3 | 25.3 | | | | **303.3** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 3d.1-3d.5
See Exhibit 4c.1 and Exhibit 4c.2.
See Exhibit 4e.1 and Exhibit 4e.2.
See Exhibit 4d.1 (Corrected) and Exhibit 4d.2 (Corrected).

**Notes:**
[1] Dr. Leonard's Base Model assumes a Sigma (σ) of 0.757 and a Beta (β) of 0.1. His counterfactual scenario includes: (a) Google Apps, (b) C++ Apps, (c) Dual-Home Apps, (d) Dual-Home Companies, and (e) Dual-Language Companies.
[2] I tested three alternative counterfactual scenarios and reported in this table. Counterfactual Scenario 1 [a] In addition to eliminating the apps that Dr. Leonard removes in this analysis, I remove the Dual-Language Company inclusion criteria. Scenario 2 [b], cumulative to Scenario 1, I remove the Dual-Home Company inclusion criteria. Scenario 3 [c] , cumulative to Scenario 2, I remove the Dual-Home inclusion criteria.
[3] I tested values of the parameter Sigma (σ) from the Kim Model within two standard errors of the parameter's value as provided by Dr. Leonard (i.e., Dr. Leonard's Sigma (σ) plus or minus the standard error of the parameter multiplied by two).
[4] I tested values of the parameter Beta (β) from the Kim Model within two standard errors of the parameter's value as provided by Dr. Leonard (i.e., Dr. Leonard's Beta (β) plus or minus the standard error of the parameter multiplied by two).
[5] Changes in Handset Sales for Android Devices represents the number of Android devices actually sold that would not have been sold in alternate scenarios. Changes in Handset Sales for iOS Devices represents the number of Android devices actually sold that would have been diverted to iOS devices in alternate scenarios.

**Exhibit 4a.2 (Corrected)**
**Summary of Sensitivity and Counterfactual Tests on Kim Model:**
**Available Applications, Percent Change in Handset Sales, and Net Loss Profit**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Apps Available** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | | | | | 751 | 762 | 1,125 | 1,175 | **2,687** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [a] Scenario 1 | | | | | 751 | 761 | 1,124 | 1,175 | **2,686** |
| [b] Scenario 2 | | | | | 525 | 581 | 822 | 854 | **1,814** |
| [c] Scenario 3 | | | | | 177 | 202 | 170 | 127 | **344** |
| Actual | | | | | 1,108 | 967 | 1,356 | 1,512 | **3,642** |
| **Percent Changes in Handset Sales** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | | | | | | | | | |
| Android Devices | -2.6 % | -2.4 % | -2.1 % | -2.0 % | -1.9 % | -1.1 % | -1.2 % | -1.0 % | **1.3** % |
| iOS Devices | 1.5 | 1.2 | 0.9 | 0.8 | 0.7 | 0.3 | 0.4 | 0.3 | **0.4** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [a] Scenario 1 | | | | | | | | | |
| Android Devices | -2.6 % | -2.4 % | -2.1 % | -2.0 % | -1.9 % | -1.1 % | -1.2 % | -1.0 % | **-1.3** % |
| iOS Devices | 1.5 | 1.2 | 0.9 | 0.8 | 0.7 | 0.3 | 0.4 | 0.3 | **0.4** |
| [b] Scenario 2 | | | | | | | | | |
| Android Devices | -10.5 % | -9.7 % | -8.6 % | -8.0 % | -7.7 % | -5.3 % | -5.1 % | -4.9 % | **5.7** % |
| iOS Devices | 5.9 | 4.9 | 3.8 | 3.2 | 2.9 | 1.7 | 1.6 | 1.6 | **-2.0** |
| [c] Scenario 3 | | | | | | | | | |
| Android Devices | -25.8 % | -23.8 % | -21.4 % | -20.1 % | -19.3 % | -21.8 % | -21.3 % | -20.1 % | **20.7** % |
| iOS Devices | 15.0 | 12.6 | 10.0 | 8.6 | 7.9 | 7.8 | 7.6 | 7.4 | **-7.8** |
| [3] Sigma (σ) Sensitivity | | | | | | | | | |
| [d] Sigma (σ)=0.607 | | | | | | | | | |
| Android Devices | -1.9 % | -1.8 % | -1.6 % | -1.6 % | 1.5 % | 0.9 % | 1.0 % | 0.8 % | **1.1** % |
| iOS Devices | 0.7 | 0.6 | 0.5 | 0.4 | 0.3 | 0.2 | 0.2 | 0.2 | **-0.2** |
| [e] Sigma (σ)=0.097 | | | | | | | | | |
| Android Devices | -5.7 % | -5.0 % | -4.2 % | -3.8 % | -3.5 % | -1.8 % | -2.1 % | -1.7 % | **2.3** % |
| iOS Devices | 4.5 | 3.8 | 2.9 | 2.5 | 2.2 | 1.0 | 1.2 | 1.0 | **-1.4** |
| [4] Beta (β) Sensitivity | | | | | | | | | |
| [f] Beta (β)=0.005 | | | | | | | | | |
| Android Devices | -1.3 % | -1.2 % | -1.1 % | -1.0 % | -0.9 % | -0.5 % | -0.6 % | -0.5 % | **0.6** % |
| iOS Devices | 0.7 | 0.6 | 0.5 | 0.4 | 0.3 | 0.2 | 0.2 | 0.2 | **-0.2** |
| [g] Beta (β)=0.015 | | | | | | | | | |
| Android Devices | -3.9 % | -3.6 % | -3.2 % | -3.0 % | -2.8 % | -1.6 % | -1.8 % | -1.5 % | **1.9** % |
| iOS Devices | 2.2 | 1.8 | 1.4 | 1.2 | 1.0 | 0.5 | 0.5 | 0.5 | **-0.6** |
| **Net Loss Profit (in millions)** | | | | | | | | | |
| [1] Dr. Leonard's Base Model | $ 0.0 | $ 0.2 | $ 1.1 | $ 4.9 | $ 17.0 | $ [redacted] | | | $ **202.6** |
| [2] Alternate Counterfactuals | | | | | | | | | |
| [b] Scenario 2 | 0.0 | 0.7 | 4.5 | 19.5 | 67.2 | | | | **932.2** |
| [c] Scenario 3 | 0.0 | 1.6 | 10.8 | 46.6 | 160.3 | | | | **3,506.5** |
| [3] Sigma (σ) Sensitivity | | | | | | | | | |
| [d] Sigma (σ)=0.607 | 0.0 | 0.2 | 1.0 | 4.6 | 16.0 | | | | **182.1** |
| [e] Sigma (σ)=0.097 | 0.0 | 0.2 | 1.6 | 6.1 | 20.6 | | | | **284.9** |
| [4] Beta (β) Sensitivity | | | | | | | | | |
| [f] Beta (β)=0.005 | 0.0 | 0.1 | 0.6 | 2.5 | 8.5 | | | | **101.8** |
| [g] Beta (β)=0.015 | 0.0 | 0.2 | 1.7 | 7.3 | 25.3 | | | | **303.3** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016, Exhibits 3d.1-3d.5
See Exhibit 4c.1 and Exhibit 4c.2.
See Exhibit 4e.1 and Exhibit 4e.2.
See Exhibit 4d.1 (Corrected) and Exhibit 4d.2 (Corrected).

**Notes:**
[1] Dr. Leonard's Base Model assumes a Sigma (σ) of 0.757 and a Beta (β) of 0.1. His counterfactual scenario includes: (a) Google Apps, (b) C++ Apps, (c) Dual-Home Apps, (d) Dual-Home Companies, and (e) Dual-Language Companies.
[2] I tested three alternative counterfactual scenarios and reported in this table. Counterfactual Scenario 1 [a] In addition to eliminating the apps that Dr. Leonard removes in this analysis, I remove the Dual-Language Company inclusion criteria. Scenario 2 [b], cumulative to Scenario 1, I remove the Dual-Home Company inclusion criteria. Scenario 3 [c] , cumulative to Scenario 2, I remove the Dual-Home inclusion criteria.
[3] I tested values of the parameter Sigma (σ) from the Kim Model within two standard errors of the parameter's value as provided by Dr. Leonard (i.e., Dr. Leonard's Sigma (σ) plus or minus the standard error of the parameter multiplied by two).
[4] I tested values of the parameter Beta (β) from the Kim Model within two standard errors of the parameter's value as provided by Dr. Leonard (i.e., Dr. Leonard's Beta (β) plus or minus the standard error of the parameter multiplied by two).
[5] Changes in Handset Sales for Android Devices represents the number of Android devices actually sold that would not have been sold in alternate scenarios. Changes in Handset Sales for iOS Devices represents the number of Android devices actually sold that would have been diverted to iOS devices in alternate scenarios.

**Exhibit 4b**
**Alternative Layout for Dr. Gregory K. Leonard's Exhibit 3d.4**
**Android U.S. Revenue Portion of Android Worldwide Revenue**

**Google Play Revenues from the United States [1]**
**[a]** Smartphone
**[c]** Android Tablet
**[e]** Overall

**Make Up of Android Devices [2]**
**[b]** Smartphone 90.0 %
**[d]** Android Tablet 10.0

**Advertising Revenue by Android Devices in the United States [1]**

**Search**
**[f]** Smartphone
**[h]** Android Tablet
**[j]** Overall

**Display**
**[g]** Smartphone
**[i]** Android Tablet
**[k]** Overall

**Worldwide Advertising Revenues by Type *(in millions)*** **[3] [4]**
**[l]** Search
**[m]** AdSense
**[n]** Display
**[o]** Total/Overall

**[p]**
**[q]**
**[r]**

**Percent of U.S. Android Revenue from Total Revenues [4]**
**[s]** Search Ads
**[t]** Display Ads
**[u]**

**Notes:**

**[1]** See GOOG-00186877-891 at 889.
**[2]** See GOOG-00186877-891 at 879.
**[3]** See Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c; GOOG-00132245, GOOG-00132625, GOOG-0022386, and GOOG-00022388; and GOOGLE-00395614.
**[4]** There are small differences between the percentages displayed here and those displayed in Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 3d.4. These differences seem to arise from rounding; those same percentages differ across his Exhibits 1c and 3d.4.

**[a]** See note [1].
**[b]** See note [2].
**[c]** See note [1].
**[d]** See note [2].
**[e]** = **[a]*[b]** + **[c]*[d]**

**[f]** See note [1].
**[g]** See note [1].
**[h]** See note [1].
**[i]** See note [1].
**[j]** = **[f]*[b]** + **[h]*[d]**
**[k]** = **[g]*[b]** + **[i]*[d]**

**[l]** See note [3].
**[m]** See note [3].
**[n]** See note [3].
**[o]** = **[l] + [m] + [n]**

**[p]** = **[l] / [o]**
**[q]** = **[m] / [o]**
**[r]** = **[n] / [o]**

**[s]** = **[j]*[p]**
**[t]** = **[k]*([q] + [r])**
**[u]** = **[s] + [t],**

**Exhibit 4c.1**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Kearl Counterfactual Scenario 2 [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0.1 | $ 1.4 | $ 10.6 | $ 50.1 | $ 189.2 | $ [redacted] | | | |
| Hardware | -- | -- | 9.2 | 0.0 | 24.3 | | | | |
| Apps | 0.0 | 0.1 | 0.6 | 2.9 | 10.9 | | | | |
| Digital Content | -- | -- | -- | 1.2 | 8.5 | | | | |
| **Total** | **$ 0.1** | **$ 1.5** | **$ 20.4** | **$ 54.1** | **$ 232.9** | $ | | | |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0.0 | $ 0.3 | $ 3.6 | $ 9.5 | $ 48.5 | $ | | | |
| Hardware | -- | -- | -- | 0.0 | 27.3 | | | | |
| Apps | -- | -- | -- | 0.0 | 5.0 | | | | |
| Digital Content | -- | -- | -- | 1.9 | 13.6 | | | | |
| Infrastructure & Other COS | -- | -- | -- | 5.4 | 7.6 | | | | |
| Operations | 0.0 | 0.0 | 0.3 | -- | -- | | | | |
| COS (including DTC) | 0.0 | 0.0 | 8.8 | -- | -- | | | | |
| **Total** | **$ 0.0** | **$ 0.3** | **$ 12.8** | **$ 16.8** | **$ 101.9** | $ | | | |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0.0 | $ 1.2 | $ 7.7 | $ 37.3 | $ 131.0 | $ | | | |
| Gross Margin (%) | 44.0 % | 78.3 % | 37.5 % | 68.9 % | 56.2 % | | | | |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | $ | | | |
| Android Marketing | -- | -- | -- | -- | -- | | | | |
| Android Legal | -- | -- | -- | -- | -- | | | | |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | |
| Incremental Search and Advertising Expenses | 0.0 | 0.1 | 0.9 | 4.1 | 15.6 | | | | |
| **Total** | **$ 0.0** | **$ 0.1** | **$ 0.9** | **$ 4.1** | **$ 15.6** | $ | | | |
| Android Advertising Share Loss | 8.8 % | 8.8 % | 8.8 % | 8.8 % | 8.8 % | | | | |
| Google Play Share Loss | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | | | | |
| Diversion Ratio | 45.2 | 45.2 | 45.2 | 45.2 | 45.2 | 42.0 | 41.4 | 43.1 | |
| Search Share | 100.0 | 76.0 | 67.3 | 76.9 | 67.1 | [redacted] | [redacted] | [redacted] | |
| Gross Loss of Profit | $ 0.0 | $ 1.0 | $ 6.8 | $ 33.2 | $ 115.3 | [redacted] | [redacted] | [redacted] | [redacted] |
| iPhone Offset | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| **Net Loss of Profit** | **$** [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **932.2** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4c.3 and Exhibit 4c.4 (Corrected).
GOOG-00130338.

**Notes:**
[1] Kearl Counterfactual Scenario 2 assumes that only Google Apps, C++ Apps, and Dual-Homed Apps would be available on Android.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4c.3. It is also displayed here for convenience. See Exhibit 4c.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted].
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4c.2**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Kearl Counterfactual Scenario 3 [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0.1 | $ 3.4 | $ 26.2 | $ 124.2 | $ 469.7 | $ | | | |
| Hardware | -- | -- | 23.1 | 0.0 | 60.8 | | | | |
| Apps | 0.0 | 0.2 | 1.6 | 7.3 | 27.3 | | | | |
| Digital Content | -- | -- | -- | 3.0 | 21.2 | | | | |
| **Total** | **$ 0.2** | **$ 3.6** | **$ 50.9** | **$ 134.5** | **$ 579.0** | **$** | | | |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0.0 | $ 0.6 | $ 9.0 | $ 23.6 | $ 120.4 | $ | | | |
| Hardware | -- | -- | -- | 0.0 | 68.3 | | | | |
| Apps | -- | -- | -- | 0.0 | 12.5 | | | | |
| Digital Content | -- | -- | -- | 4.7 | 34.0 | | | | |
| Infrastructure & Other COS | -- | -- | -- | 13.6 | 19.0 | | | | |
| Operations | 0.0 | 0.1 | 0.9 | -- | -- | | | | |
| COS (including DTC) | 0.0 | 0.1 | 22.0 | -- | -- | | | | |
| **Total** | **$ 0.1** | **$ 0.8** | **$ 31.9** | **$ 41.9** | **$ 254.1** | **$** | | | |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0.1 | $ 2.9 | $ 19.0 | $ 92.6 | $ 324.9 | $ | | | |
| Gross Margin (%) | 43.7 % | 78.3 % | 37.4 % | 68.8 % | 56.1 % | | | | |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | $ | | | |
| Android Marketing | -- | -- | -- | -- | -- | | | | |
| Android Legal | -- | -- | -- | -- | -- | | | | |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | |
| Incremental Search and Advertising Expenses | 0.0 | 0.3 | 2.2 | 10.3 | 38.8 | | | | |
| **Total** | **$ 0.0** | **$ 0.3** | **$ 2.2** | **$ 10.3** | **$ 38.8** | **$** | | | |
| Android Advertising Share Loss | 21.8 % | 21.8 % | 21.8 % | 21.8 % | 21.8 % | | | | |
| Google Play Share Loss | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | | | | |
| Diversion Ratio | 47.7 | 47.7 | 47.7 | 47.7 | 47.7 | 45.7 | 45.1 | 46.6 | |
| Search Share | 100.0 | 76.0 | 67.3 | 76.9 | 67.1 | [redacted] | [redacted] | [redacted] | |
| Gross Loss of Profit | $ 0.1 | $ 2.6 | $ 16.9 | $ 82.3 | $ 286.1 | [redacted] | [redacted] | [redacted] | [redacted] |
| iPhone Offset | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| **Net Loss of Profit** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **$ 3,506.5** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4c.3 and Exhibit 4c.4 (Corrected).
GOOG-00130338.

**Notes:**
[1] Kearl Counterfactual Scenario 3 assumes that only Google Apps and C++ Apps would be available on Android.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4c.3. It is also displayed here for convenience. See Exhibit 4c.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted].
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4c.3**
**Dr. Gregory K. Leonard's Exhibit 3d.2 Under Dr. Leonard's Counterfactual and Kearl Counterfactual Scenarios 2 and 3 [1]**
**Ad and Play Revenue Loss Percentages and Ad Diversion Ratios**

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| **Percentage of Revenue in the U.S.** | | | | | | | |
| Percentage of Ad Revenue in the US [2] | | | | | [redacted] | | |
| Percentage of Play Revenue in the US [2] | | | | | [redacted] | | |
| **Revenue Loss and Diversion Ratio** | | | | | | | |
| Ad Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model [3] | -2.2 % | -2.2 % | -2.2 % | -2.2 % | -1.3 % | -1.4 % | -1.2 % |
| Scenario 2 | -8.8 | -8.8 | -8.8 | -8.8 | -6.5 | -6.1 | -5.9 |
| Scenario 3 | -21.8 | -21.8 | -21.8 | -21.8 | -25.9 | -25.1 | -24.0 |
| Ad Revenue Diversion Ratio | | | | | | | |
| Dr. Leonard's Base Model [3] | 44.0 % | 44.0 % | 44.0 % | 44.0 % | 41.0 % | 40.5 % | 42.2 % |
| Scenario 2 | 45.2 | 45.2 | 45.2 | 45.2 | 42.0 | 41.4 | 43.1 |
| Scenario 3 | 47.7 | 47.7 | 47.7 | 47.7 | 45.7 | 45.1 | 46.6 |
| Play Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model [3] | -2.0 % | -2.0 % | -2.0 % | -2.0 % | -1.2 % | -1.3 % | -1.1 % |
| Scenario 2 | -8.0 | -8.0 | -8.0 | -8.0 | -5.8 | -5.5 | -5.3 |
| Scenario 3 | -20.0 | -20.0 | -20.0 | -20.0 | -23.4 | -22.7 | -21.6 |

**Sources:**
See Exhibit 4b.
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 3d.3 - 3d.5.
GOOG-00186877

**Notes:**
[1] Kearl Counterfactual Scenario 2 assumes that only Google Apps, C++ Apps, and Dual-Homed Apps would be available on Android. Kearl Counterfactual Scenario 3 assumes that only Google Apps and C++ Apps would be available on Android.
[2] U.S. revenue percentages are set equal to 2013 value. See GOOG-00186877 at 889. Exhibit 3d.4 of the Expert Report of Dr. Gregory K. Leonard dated February 8, 2016, goes into some detail of their derivation. I verified Dr. Leonard's calculations from Exhibit 3d.4. See Exhibit 4b for clarification.
[3] Ad Revenue Loss, Ad Revenue Diversion Ratio, and Play Revenue Loss for Kearl Scenario 1 are indistinguishable from Dr. Leonard's Base Model.

**Exhibit 4c.4 (Corrected)**
**Dr. Gregory K. Leonard's Exhibit 3d.3 Under Dr. Leonard's Counterfactual and Kearl Counterfactual Scenarios 2 and 3 [1]**
**User Loss, Diversion Ratios, and Changes in Handset Sales**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| **United States** | | | | | | | | |
| **[a]** User Loss [3] | | | | | | | | |
| Dr. Leonard's Base Model [2] | | | | | -2.7 % | -1.7 % | -1.8 % | -1.5 % |
| Scenario 2 | | | | | -10.7 | -8.3 | -7.6 | -7.5 |
| Scenario 3 | | | | | -26.1 | -32.1 | -30.8 | -29.5 |
| **[b]** Diversion Ratio (Android to iOS) [3] | | | | | | | | |
| Dr. Leonard's Base Model [2] | | | | | 56.1 % | 56.8 % | 55.3 % | 57.1 % |
| Scenario 2 | | | | | 57.2 | 57.7 | 56.2 | 57.9 |
| Scenario 3 | | | | | 59.2 | 60.6 | 59.2 | 60.6 |
| **Rest of World** | | | | | | | | |
| **[c]** User Loss [3] | | | | | | | | |
| Dr. Leonard's Base Model [2] | | | | | -1.8 % | -1.0 % | -1.1 % | -0.9 % |
| Scenario 2 | | | | | -7.2 | -5.0 | -4.8 | -4.7 |
| Scenario 3 | | | | | -18.2 | -20.7 | -20.3 | -19.3 |
| **[d]** Diversion Ratio (Android to iOS) [3] | | | | | | | | |
| Dr. Leonard's Base Model [2] | | | | | 33.9 % | 27.7 % | 28.0 % | 29.8 % |
| Scenario 2 | | | | | 35.2 | 28.8 | 29.0 | 30.8 |
| Scenario 3 | | | | | 38.0 | 33.2 | 33.2 | 34.8 |
| **Worldwide** | | | | | | | | |
| **[e]** Diversion Ratio (Android to iOS) [3] [4] | | | | | | | | |
| Dr. Leonard's Base Model [2] | 55 2 % | 49.5 % | 42 9 % | 39.1 % | 36.8 % | 30.4 % | 30.5 % | 32.0 % |
| Scenario 2 | 56 3 | 50.6 | 44.1 | 40.4 | 38.1 | 31.5 | 31.4 | 33.0 |
| Scenario 3 | 58 3 | 52.8 | 46.6 | 43.0 | 40.8 | 35.7 | 35.6 | 36.9 |
| **Percent of Android Sales Worldwide** | | | | | | | | |
| **[f]** United States | 95.6 % | 70.1 % | 40 5 % | 23.5 % | 13.3 % | 9.4 % | 9.1 % | 8.1 % |
| **[g]** Rest of the World | 4.4 | 29.9 | 59 5 | 76.5 | 86.7 | 90.6 | 90.9 | 91.9 |
| **Changes in Handset Sales (*Worldwide in Thousands)*** | | | | | | | | |
| **[h]** Android Devices | | | | | | | | |
| Dr. Leonard's Base Model [2] | -18 2 | -168.2 | -1,512 2 | -4,797.8 | -9,412.4 | -8,657.2 | -12,545.3 | -8,173.4 |
| Scenario 2 | -72 9 | -676.7 | -6,122 5 | -19,510.6 | -38,390.7 | -42,714.7 | -53,910.0 | -41,381.9 |
| Scenario 3 | -178 2 | -1,665.9 | -15,226 2 | -48,857.8 | -96,585.1 | -174,739.7 | -225,463.4 | -169,680.8 |
| **[i]** iOS Devices | | | | | | | | |
| Dr. Leonard's Base Model [2] | 10 0 | 83.2 | 648.4 | 1,876.0 | 3,466.2 | 2,636.0 | 3,822.1 | 2,614.7 |
| Scenario 2 | 41 0 | 342.6 | 2,700 8 | 7,877.8 | 14,637.6 | 13,455.1 | 16,947.1 | 13,647.5 |
| Scenario 3 | 103 8 | 880.4 | 7,090.6 | 20,995.0 | 39,412.2 | 62,459.0 | 80,209.9 | 62,666.2 |

**Sources:**
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 3d.5.
"WW Quarterly Mobile Phone Tracker," IDC, November 13, 2015.

**Notes:**
[1] Kearl Counterfactual Scenario 2 assumes that only Google Apps, C++ Apps, and Dual-Homed Apps would be available on Android. Kearl Counterfactual Scenario 3 assumes that only Google Apps and C++ Apps would be available on Android.
[2] Dr. Leonard's values for User Loss, Diversion Ratio, and Changes in Handset Sales for the U S., Rest of World and Worldwide are indistinguishable from Kearl Scenario 1.
[3] These values are determined by solving the system of equations as described in the Expert Report of Dr. Gregory K. Leonard, dated February 8, 2016, in paras. 187-190.
[4] This is equal to **[b]** * **[f]** + **[d]** * **[g]**, values for **[b]** and **[d]** from 2009 - 2011 are assumed to be equal to 2012. This is for convenience, not as an endorsement of the validity of such an approach or assumption.

**Exhibit 4d.1 (Corrected)**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Beta (β) = 0.005 Sensitivity Test [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0.0 | $ 0.2 | $ 1.3 | $ 6.2 | $ 23.5 | $ | | | 200.0 |
| Hardware | -- | -- | 1.1 | 0.0 | 3.0 | | | | 13.2 |
| Apps | 0.0 | 0.0 | 0.1 | 0.4 | 1.3 | | | | 46.8 |
| Digital Content | -- | -- | -- | 0.1 | 1.0 | | | | 10.1 |
| **Total** | **$ 0.0** | **$ 0.2** | **$ 2.5** | **$ 6.7** | **$ 28.8** | **$** | | | **270.2** |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0.0 | $ 0.0 | $ 0.4 | $ 1.2 | $ 6.0 | $ | | | 55.4 |
| Hardware | -- | -- | -- | 0.0 | 3.4 | | | | 14.8 |
| Apps | -- | -- | -- | 0.0 | 0.6 | | | | 17.1 |
| Digital Content | -- | -- | -- | 0.2 | 1.7 | | | | 11.7 |
| Infrastructure & Other COS | -- | -- | -- | 0.7 | 0.9 | | | | 6.5 |
| Operations | 0.0 | 0.0 | 0.0 | -- | -- | | | | 0.0 |
| COS (including DTC) | 0.0 | 0.0 | 1.1 | -- | -- | | | | 1.1 |
| **Total** | **$ 0.0** | **$ 0.0** | **$ 1.6** | **$ 2.1** | **$ 12.6** | **$** | | | **106.6** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0.0 | $ 0.1 | $ 0.9 | $ 4.6 | $ 16.2 | $ | | | 163.6 |
| Gross Margin (%) | 44.1 % | 78.3 % | 37.6 % | 69.0 % | 56.3 % | | | | 60.5 % |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | $ | | | -- |
| Android Marketing | -- | -- | -- | -- | -- | | | | -- |
| Android Legal | -- | -- | -- | -- | -- | | | | -- |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | -- |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | -- |
| Incremental Search and Advertising Expenses | 0.0 | 0.0 | 0.1 | 0.5 | 1.9 | | | | 16.5 |
| **Total** | **$ 0.0** | **$ 0.0** | **$ 0.1** | **$ 0.5** | **$ 1.9** | **$** | | | **16.5** |
| Android Advertising Share Loss | 1.1 % | 1.1 % | 1.1 % | 1.1 % | 1.1 % | | | | |
| Google Play Share Loss | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | | | | |
| Diversion Ratio | 43.8 | 43.8 | 43.8 | 43.8 | 43.8 | 40.8 | 40.3 | 42.0 | |
| Search Share | 100.0 | 76.0 | 67.3 | 76.9 | 67.1 | [redacted] | | | |
| Gross Loss of Profit | $ 0.0 | $ 0.1 | $ 0.8 | $ 4.1 | $ 14.3 | $ | | | 147.0 |
| iPhone Offset | [redacted] | | | | | | | | |
| **Net Loss of Profit** | [redacted] | | | | | | | | **101.8** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4d.3 and Exhibit 4d.4.
GOOG-00130338.

**Notes:**
[1] The Beta (β) term in the Kim model has been altered from 0.01 to 0.005 to test the sensitivity of the model. This number is two standard errors below the original.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4d.3. It is also displayed here for convenience. See Exhibit 4d.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted]
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4d.2 (Corrected)**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Beta (β) = 0.015 Sensitivity Test [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0.0 | $ 0.5 | $ 3.9 | $ 18.5 | $ 70.0 | | | | 597.9 |
| Hardware | -- | -- | 3.4 | 0.0 | 8.9 | | | | 39.6 |
| Apps | 0.0 | 0.0 | 0.2 | 1.1 | 4.0 | | | | 140.2 |
| Digital Content | -- | -- | -- | 0.4 | 3.1 | | | | 30.2 |
| **Total** | **$ 0.0** | **$ 0.5** | **$ 7.5** | **$ 20.0** | **$ 86.1** | | | | **807.8** |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0.0 | $ 0.1 | $ 1.3 | $ 3.5 | $ 17.9 | | | | 165.6 |
| Hardware | -- | -- | -- | 0.0 | 10.0 | | | | 44.4 |
| Apps | -- | -- | -- | 0.0 | 1.8 | | | | 51.1 |
| Digital Content | -- | -- | -- | 0.7 | 5.0 | | | | 34.9 |
| Infrastructure & Other COS | -- | -- | -- | 2.0 | 2.8 | | | | 19.5 |
| Operations | 0.0 | 0.0 | 0.1 | -- | -- | | | | 0.1 |
| COS (including DTC) | 0.0 | 0.0 | 3.2 | -- | -- | | | | 3.2 |
| **Total** | **$ 0.0** | **$ 0.1** | **$ 4.7** | **$ 6.2** | **$ 37.6** | | | | **318.8** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0.0 | $ 0.4 | $ 2.8 | $ 13.8 | $ 48.5 | | | | 489.0 |
| Gross Margin (%) | 44.1 % | 78.3 % | 37.6 % | 69.0 % | 56.3 % | | | | 60.5 % |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | | | | -- |
| Android Marketing | -- | -- | -- | -- | -- | | | | -- |
| Android Legal | -- | -- | -- | -- | -- | | | | -- |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | -- |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | -- |
| Incremental Search and Advertising Expenses | 0.0 | 0.0 | 0.3 | 1.5 | 5.8 | | | | 49.4 |
| **Total** | **$ 0.0** | **$ 0.0** | **$ 0.3** | **$ 1.5** | **$ 5.8** | | | | **49.4** |
| Android Advertising Share Loss | 3.3 % | 3.3 % | 3.3 % | 3.3 % | 3.3 % | | | | |
| Google Play Share Loss | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | | | | |
| Diversion Ratio | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | | | | |
| Search Share | 100.0 | 76.0 | 67.3 | 76.9 | 67.1 | | | | |
| Gross Loss of Profit | $ 0.0 | $ 0.4 | $ 2.5 | $ 12.3 | $ 42.7 | | | | 439.6 |
| iPhone Offset | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | | | | 136.3) |
| **Net Loss of Profit** | **$** [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | | | | **303.3** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4d.3 and Exhibit 4d.4.
GOOG-00130338.

**Notes:**
[1] The Beta (β) term in the Kim model has been altered from 0.01 to 0.015 to test the sensitivity of the model. This number is two standard errors above the original.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4d.3. It is also displayed here for convenience. See Exhibit 4d.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted]
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4d.3**
**Dr. Gregory K. Leonard's Exhibit 3d.2 Under Dr. Leonard's Default Beta (β) and Kearl Beta (β) Sensitivity Tests [1]**
**Ad and Play Revenue Loss Percentages and Ad Diversion Ratios**

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| **Percentage of Revenue in the U.S.** | | | | | | | |
| Percentage of Ad Revenue in the US [2] | | | | | [redacted] | | |
| Percentage of Play Revenue in the US [2] | | | | | [redacted] | | |
| **Revenue Loss and Diversion Ratio** | | | | | | | |
| Ad Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0.01) | -2.2 % | -2.2 % | -2.2 % | -2.2 % | -1.3 % | -1.4 % | -1.2 % |
| Beta (β)=0.005 | -1.1 | -1.1 | -1.1 | -1.1 | -0.7 | -0.7 | -0.6 |
| Beta (β)=0.015 | -3.3 | -3.3 | -3.3 | -3.3 | -2.0 | -2.1 | -1.8 |
| Ad Revenue Diversion Ratio | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0.01) | 44.0 % | 44.0 % | 44.0 % | 44.0 % | 41.0 % | 40.5 % | 42.2 % |
| Beta (β)=0.005 | 43.8 | 43.8 | 43.8 | 43.8 | 40.8 | 40.3 | 42.0 |
| Beta (β)=0.015 | 44.2 | 44.2 | 44.2 | 44.2 | 41.1 | 40.6 | 42.4 |
| Play Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0.01) | -2.0 % | -2.0 % | -2.0 % | -2.0 % | -1.2 % | -1.3 % | -1.1 % |
| Beta (β)=0.005 | -1.0 | -1.0 | -1.0 | -1.0 | -0.6 | -0.6 | -0.5 |
| Beta (β)=0.015 | -2.9 | -2.9 | -2.9 | -2.9 | -1.8 | -1.9 | -1.6 |

**Sources:**
See Exhibit 4b.
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 3d.3 - 3d.5.
GOOG-00186877

**Notes:**
[1] Values of Beta (β) = 0.005 and Beta (β) = 0.015 were used for sensitivity testing of the Kim Model. Dr. Leonard sets Beta (β) = 0.01 for his
[2] U.S. revenue percentages are set equal to 2013 value. See GOOG-00186877 at 889. Exhibit 3d.4 of the Expert Report of Dr. Gregory K. Leonard dated February 8, 2016, goes into some detail of their derivation. I verified Dr. Leonard's calculations from Exhibit 3d.4. See Exhibit 4b for clarification.

**Exhibit 4d.4**
**Dr. Gregory K. Leonard's Exhibit 3d.3 Under Dr. Leonard's Default Beta (β) and Kearl Beta (β) Sensitivity Tests [1]**
**User Loss, Diversion Ratios, and Changes in Handset Sales**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| **United States** | | | | | | | | |
| **[a]** User Loss [4] | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | | | | | -2.7 % | -1.7 % | -1 8 % | -1 5 % |
| Beta (β)=0.005 | | | | | -1.3 | -0.8 | -0 9 | -0.7 |
| Beta (β)=0.015 | | | | | -4.0 | -2.5 | -2.7 | -2 2 |
| **[b]** Diversion Ratio (Android to iOS) [4] | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | | | | | 56.1 % | 56.8 % | 55 3 % | 57.1 % |
| Beta (β)=0.005 | | | | | 55.9 | 56.7 | 55 2 | 56 9 |
| Beta (β)=0.015 | | | | | 56.3 | 56.9 | 55 5 | 57 2 |
| **Rest of World** | | | | | | | | |
| **[c]** User Loss [4] | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | | | | | -1.8 % | -1.0 % | -1.1 % | -0 9 % |
| Beta (β)=0.005 | | | | | -0.9 | -0.5 | -0.6 | -0 5 |
| Beta (β)=0.015 | | | | | -2.6 | -1.5 | -1.7 | -1.4 |
| **[d]** Diversion Ratio (Android to iOS) [4] | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | | | | | 33.9 % | 27.7 % | 28 0 % | 29 8 % |
| Beta (β)=0.005 | | | | | 33.6 | 27.5 | 27 8 | 29.6 |
| Beta (β)=0.015 | | | | | 34.1 | 27.9 | 28.1 | 29 9 |
| **Worldwide** | | | | | | | | |
| **[e]** Diversion Ratio (Android to iOS) [4] [5] | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | 55 2 % | 49.5 % | 42.9 % | 39.1 % | 36.8 % | 30.4 % | 30 5 % | 32 0 % |
| Beta (β)=0.005 | 55 0 | 49.3 | 42.6 | 38.9 | 36.6 | 30.3 | 30 3 | 31 8 |
| Beta (β)=0.015 | 55.4 | 49.7 | 43.1 | 39.3 | 36.6 | 30.3 | 30 3 | 31 8 |
| **Percent of Android Sales Worldwide** | | | | | | | | |
| **[f]** United States | 95.6 % | 70.1 % | 40.5 % | 23.5 % | 13.3 % | 9.4 % | 9.1 % | 8.1 % |
| **[g]** Rest of the World | 4.4 | 29.9 | 59.5 | 76.5 | 86.7 | 90.6 | 90 9 | 91 9 |
| **Changes in Handset Sales (*Worldwide in Thousands)*** | | | | | | | | |
| **[h]** Android Devices | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | -18 2 | -168.2 | -1,512.2 | -4,797.8 | -9,412.4 | -8,657.2 | -12,545 3 | -8,173.4 |
| Beta (β)=0.005 | -9.1 | -84.4 | -758.0 | -2,404.0 | -4,714.9 | -4,333.7 | -6,279 5 | -4,091 3 |
| Beta (β)=0.015 | -27 2 | -251.6 | -2,262.9 | -7,182.2 | -14,093.5 | -12,973.7 | -18,798 9 | -12,251 8 |
| **[i]** iOS Devices | | | | | | | | |
| Dr. Leonard's Base Model (Beta (β) = 0 01) | 10 0 | 83.2 | 648.4 | 1,876.0 | 3,466.2 | 2,636.0 | 3,822.1 | 2,614.7 |
| Beta (β)=0.005 | 5 0 | 41.5 | 323.2 | 934.0 | 1,724.4 | 1,311.7 | 1,902 8 | 1,300.1 |
| Beta (β)=0.015 | 15.1 | 125.0 | 975.0 | 2,823.4 | 5,154.5 | 3,926.7 | 5,696 5 | 3,893 3 |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 3d 5.
"WW Quarterly Mobile Phone Tracker," IDC, November 13, 2015.

**Notes:**
[1] Values of Beta (β) = 0 005 and Beta (β) = 0.015 were used for sensitivity testing of the Kim Model. Dr. Leonard sets Beta (β) = 0.01 for his calculations.
[2] As per Dr. Min Jung Kim's instructions, Dr. Leonard uses a value of 0.757 for Sigma (σ). See Expert Report of Dr. Gregory K. Leonard, dated February 8, 2016, footnote 280.
[3] Sensitivity tests were conducted using Dr. Leonard's Sigma (σ) plus and minus two standard errors.
[4] These values are determined by solving the system of equations as described in the Expert Report of Dr. Gregory K. Leonard, dated February 8, 2016, in ¶¶187-190.
[5] This is equal to **[b]** * **[f]** + **[d]** * **[g]**, values for **[b]** and **[d]** from 2009 - 2011 are assumed to be equal to 2012. This is for convenience, not as an endorsement of the validity of such an approach or assumption.

**Exhibit 4e.1**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Sigma (σ) = 0.607 Sensitivity Test [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0 0 | $ 0.3 | $ 2.0 | $ 9 5 | $ 35.9 | | | | |
| Hardware | -- | -- | 1.8 | 0 0 | 4.7 | | | | |
| Apps | 0 0 | 0.0 | 0.1 | 0.6 | 2.1 | | | | |
| Digital Content | -- | -- | -- | 0 2 | 1.6 | | | | |
| **Total** | **$ 0.0** | **$ 0.3** | **$ 3.9** | **$ 10.3** | **$ 44.3** | | | | |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0 0 | $ 0.0 | $ 0.7 | $ 1 8 | $ 9.2 | | | | |
| Hardware | -- | -- | -- | 0 0 | 5.3 | | | | |
| Apps | -- | -- | -- | 0 0 | 1.0 | | | | |
| Digital Content | -- | -- | -- | 0.4 | 2.6 | | | | |
| Infrastructure & Other COS | -- | -- | -- | 1.1 | 1.5 | | | | |
| Operations | 0 0 | 0.0 | 0.1 | -- | -- | | | | |
| COS (including DTC) | 0 0 | 0.0 | 1.7 | -- | -- | | | | |
| **Total** | **$ 0.0** | **$ 0.1** | **$ 2.5** | **$ 3.2** | **$ 19.6** | | | | |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0 0 | $ 0.2 | $ 1.5 | $ 7.1 | $ 24.8 | | | | |
| Gross Margin (%) | 43 3 % | 78.2 % | 37.1 % | 68.7 % | 55.9 % | | | | |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | | | | |
| Android Marketing | -- | -- | -- | -- | -- | | | | |
| Android Legal | -- | -- | -- | -- | -- | | | | |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | |
| Incremental Search and Advertising Expenses | 0 0 | 0.0 | 0.2 | 0 8 | 3.0 | | | | |
| **Total** | **$ 0.0** | **$ 0.0** | **$ 0.2** | **$ 0.8** | **$ 3.0** | | | | |
| Android Advertising Share Loss | 1.7 % | 1.7 % | 1.7 % | 1.7 % | 1.7 % | | | | |
| Google Play Share Loss | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | | | | |
| Diversion Ratio | 28 9 | 28.9 | 28.9 | 28 9 | 28.9 | 26 9 | 26.5 | 27.8 | |
| Search Share | 100 0 | 76.0 | 67.3 | 76 9 | 67.1 | 64 9 | 65.2 | 68.6 | |
| Gross Loss of Profit | $ 0 0 | $ 0.2 | $ 1.3 | $ 6 3 | $ 21.8 | $ [redacted] | [redacted] | [redacted] | [redacted] |
| iPhone Offset | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |
| **Net Loss of Profit** | **$ [redacted]** | **[redacted]** | **[redacted]** | **[redacted]** | **[redacted]** | **[redacted]** | **[redacted]** | **[redacted]** | **$ 182.1** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4e.3 and Exhibit 4e.4.
GOOG-00130338.

**Notes:**
[1] The Sigma (σ) term in the Kim Model has been altered from 0.757 to 0.607 to test the sensitivity of the model. This number is two standard errors below the original.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4e.3. It is also displayed here for convenience. See Exhibit 4e.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted]
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4e.2**
**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Sigma (σ) = 0.907 Sensitivity Test [1]**
**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0 0 | $ 0.7 | $ 5.2 | $ 24 9 | $ 94.0 | | | | |
| Hardware | -- | -- | 4.3 | 0 0 | 11.4 | | | | |
| Apps | 0 0 | 0.0 | 0.3 | 1.4 | 5.1 | | | | |
| Digital Content | -- | -- | -- | 0.6 | 4.0 | | | | |
| **Total** | **$ 0.0** | **$ 0.7** | **$ 9.9** | **$ 26.8** | **$ 114.5** | | | | |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0 0 | $ 0.1 | $ 1.8 | $ 4.7 | $ 24.1 | | | | |
| Hardware | -- | -- | -- | 0 0 | 12.8 | | | | |
| Apps | -- | -- | -- | 0 0 | 2.3 | | | | |
| Digital Content | -- | -- | -- | 0 9 | 6.4 | | | | |
| Infrastructure & Other COS | -- | -- | -- | 2.6 | 3.6 | | | | |
| Operations | 0 0 | 0.0 | 0.2 | -- | -- | | | | |
| COS (including DTC) | 0 0 | 0.0 | 4.1 | -- | -- | | | | |
| **Total** | **$ 0.0** | **$ 0.2** | **$ 6.1** | **$ 8.2** | **$ 49.2** | | | | |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0 0 | $ 0.6 | $ 3.8 | $ 18.6 | $ 65.3 | | | | |
| Gross Margin (%) | 45.4 % | 78.5 % | 38.3 % | 69 5 % | 57.0 % | | | | |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | | | | |
| Android Marketing | -- | -- | -- | -- | -- | | | | |
| Android Legal | -- | -- | -- | -- | -- | | | | |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | |
| Incremental Search and Advertising Expenses | 0 0 | 0.1 | 0.4 | 2.1 | 7.8 | | | | |
| **Total** | **$ 0.0** | **$ 0.1** | **$ 0.4** | **$ 2.1** | **$ 7.8** | | | | |
| Android Advertising Share Loss | 4.4 % | 4.4 % | 4.4 % | 4.4 % | 4.4 % | | | | |
| Google Play Share Loss | 3 8 | 3.8 | 3.8 | 3 8 | 3.8 | | | | |
| Diversion Ratio | 70 0 | 70.0 | 70.0 | 70 0 | 70.0 | 66.4 | 65.9 | 67.9 | |
| Search Share | 100 0 | 76.0 | 67.3 | 76 9 | 67.1 | [redacted] | [redacted] | [redacted] | |
| Gross Loss of Profit | $ 0 0 | $ 0.5 | $ 3.4 | $ 16.6 | $ 57.6 | $ [redacted] | [redacted] | [redacted] | [redacted] |
| iPhone Offset | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] ) |
| **Net Loss of Profit** | **$** [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | **$ 284.9** |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 1a.1, 1c, 3d.1, 3d.2, 3d.3, 3d.4, and 3d.5.
See Exhibit 4e.3 and Exhibit 4e.4.
GOOG-00130338.

**Notes:**
[1] The Sigma (σ) term in the Kim Model has been altered from 0.757 to 0.907 to test the sensitivity of the model. This number is two standard errors above the original.
[2] Ads revenue, TAC, and Incremental Search and Advertising Expenses are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Android Advertising Share Loss, as was done by Dr. Leonard in his original report.
[3] Revenue and COS for Hardware, Apps and Digital Content are from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1a.1 and are multiplied by the Google Play Share Loss from Exhibit 4e.3. It is also displayed here for convenience. See Exhibit 4e.3 for further clarification. As in Dr. Leonard's original work, the 2012 share is used for 2008-2011.
[4] See item AdSense from Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 1c for clarification.
[5] The Gross Loss of Profit is calculated as (Total Revenue - Total COS - Incremental Search and Advertising Expenses).
[6] [redacted].
[7] Net Loss of Profit is the Gross Loss of Profit less the iPhone Offset.

**Exhibit 4e.3**
**Dr. Gregory K. Leonard's Exhibit 3d.2 Under Dr. Leonard's Default Sigma (σ) and Kearl Sigma (σ) Sensitivity Tests [1]**
**Ad and Play Revenue Loss Percentages and Ad Diversion Ratios**

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| **Percentage of Revenue in the U.S.** | | | | | | | |
| Percentage of Ad Revenue in the US [2] | | | | | [redacted] | | |
| Percentage of Play Revenue in the US [2] | | | | | | | |
| **Revenue Loss and Diversion Ratio** | | | | | | | |
| Ad Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | -2.2 % | -2.2 % | -2.2 % | -2.2 % | -1.3 % | -1.4 % | -1.2 % |
| Sigma (σ) = 0.607 | -1.7 | -1.7 | -1.7 | -1.7 | -1.0 | -1.1 | -0.9 |
| Sigma (σ) = 0.907 | -4.4 | -4.4 | -4.4 | -4.4 | -2.6 | -2.8 | -2.3 |
| Ad Revenue Diversion Ratio | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | 44.0 % | 44.0 % | 44.0 % | 44.0 % | 41.0 % | 40.5 % | 42.2 % |
| Sigma (σ) = 0.607 | 28.9 | 28.9 | 28.9 | 28.9 | 26.9 | 26.5 | 27.8 |
| Sigma (σ) = 0.907 | 70.0 | 70.0 | 70.0 | 70.0 | 66.4 | 65.9 | 67.9 |
| Play Revenue Loss | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | -2.0 % | -2.0 % | -2.0 % | -2.0 % | -1.2 % | -1.3 % | -1.1 % |
| Sigma (σ) = 0.607 | -1.6 | -1.6 | -1.6 | -1.6 | -1.0 | -1.0 | -0.9 |
| Sigma (σ) = 0.907 | -3.8 | -3.8 | -3.8 | -3.8 | -2.1 | -2.4 | -1.9 |

**Sources:**
See Exhibit 4b.
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibits 3d.3 - 3d.5.
GOOG-00186877

**Notes:**
[1] Values of Sigma (σ) = 0.607 and Sigma (σ) = 0.907 were used for sensitivity testing of the Kim Model. Dr. Leonard sets Sigma (σ) = 0.757 for his calculations.
[2] U.S. revenue percentages are set equal to 2013 value. See GOOG-00186877 at 889. Exhibit 3d.4 of the Expert Report of Dr. Gregory K. Leonard dated February 8, 2016, goes into some detail of their derivation. I verified Dr. Leonard's calculations from Exhibit 3d.4. See Exhibit 4b for clarification.

**Exhibit 4e.4**
**Dr. Gregory K. Leonard's Exhibit 3d.3 Under Dr. Leonard's Default Sigma (σ) and Kearl Sigma (σ) Sensitivity Tests [1]**
**User Loss, Diversion Ratios, and Changes in Handset Sales**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| **United States** | | | | | | | | |
| **[a]** User Loss [4] | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | | | | | -2.7 % | -1.7 % | -1.8 % | -1.5 % |
| Sigma (σ) = 0.607 | | | | | -1 9 | -1 2 | -1.3 | -1.1 |
| Sigma (σ) = 0.907 | | | | | -26.1 | -32.1 | -30.8 | -29.5 |
| **[b]** Diversion Ratio (Android to iOS) [4] | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | | | | | 56.1 % | 56 8 % | 55.3 % | 57.1 % |
| Sigma (σ) = 0.607 | | | | | 39.1 | 39.7 | 38.5 | 40.0 |
| Sigma (σ) = 0.907 | | | | | 59 2 | 60.6 | 59.2 | 60.6 |
| **Rest of World** | | | | | | | | |
| **[c]** User Loss [4] | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | | | | | -1 8 % | -1 0 % | -1.1 % | -0.9 % |
| Sigma (σ) = 0.607 | | | | | -1.4 | -0 9 | -1.0 | -0.8 |
| Sigma (σ) = 0.907 | | | | | -18 2 | -20.7 | -20.3 | -19.3 |
| **[d]** Diversion Ratio (Android to iOS) [4] | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | | | | | 33 9 % | 27.7 % | 28.0 % | 29.8 % |
| Sigma (σ) = 0.607 | | | | | 20.4 | 16.1 | 16.4 | 17.5 |
| Sigma (σ) = 0.907 | | | | | 38 0 | 33 2 | 33.2 | 34.8 |
| **Worldwide** | | | | | | | | |
| **[e]** Diversion Ratio (Android to iOS) [4] [5] | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | 55.2 % | 49 5 % | 42 9 % | 39.1 % | 36 8 % | 30.4 % | 30.5 % | 32.0 % |
| Sigma (σ) = 0.607 | 38.2 | 33 5 | 28 0 | 24.8 | 36.6 | 30 3 | 30.3 | 31.8 |
| Sigma (σ) = 0.907 | 79.4 | 74.6 | 69 0 | 65.9 | 36.6 | 30 3 | 30.3 | 31.8 |
| **Percent of Android Sales Worldwide** | | | | | | | | |
| **[f]** United States | 95.6 % | 70.1 % | 40 5 % | 23.5 % | 13 3 % | 9.4 % | 9.1 % | 8.1 % |
| **[g]** Rest of the World | 4.4 | 29 9 | 59 5 | 76.5 | 86.7 | 90.6 | 90.9 | 91.9 |
| **Changes in Handset Sales (*Worldwide in Thousands)*** | | | | | | | | |
| **[h]** Android Devices | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | -18.2 | -168 2 | -1,512 2 | -4,797.8 | -9,412.4 | -8,657 2 | -12,545.3 | -8,173.4 |
| Sigma (σ) = 0.607 | -13.2 | -125 3 | -1,166 5 | -3,790.1 | -7,554.6 | -7,287.7 | -10,392.8 | -6,823.6 |
| Sigma (σ) = 0.907 | -39.5 | -352.6 | -3,006.6 | -9,177.1 | -17,519 2 | -14,570 8 | -21,854.3 | -13,989.5 |
| **[i]** iOS Devices | | | | | | | | |
| Dr. Leonard's Base Model (Sigma (σ) = 0.757) | 10.0 | 83 2 | 648.4 | 1,876.0 | 3,466 2 | 2,636 0 | 3,822.1 | 2,614.7 |
| Sigma (σ) = 0.607 | 5.1 | 41 9 | 326 2 | 939.9 | 2,763 0 | 2,205 8 | 3,149.2 | 2,168.4 |
| Sigma (σ) = 0.907 | 31.4 | 263 0 | 2,075 9 | 6,045.2 | 6,407.4 | 4,410.1 | 6,622.3 | 4,445.5 |

**Sources:**
Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 3d 5.
"WW Quarterly Mobile Phone Tracker," IDC, November 13, 2015.

**Notes:**
[1] Values of Sigma (σ) = 0.607 and Sigma (σ) = 0.907 were used for sensitivity testing of the Kim Model. Dr. Leonard sets Sigma (σ) = 0.757 for his calculations.
[2] As per Dr. Min Jung Kim's instructions, Dr. Leonard uses a value of 0.757 for Sigma (σ). See Expert Report of Dr. Gregory K. Leonard, dated February 8, 2016, footnote 282.
[3] Sensitivity tests were conducted using Dr. Leonard's Sigma (σ) plus and minus two standard errors.
[4] These values are determined by solving the system of equations as described in the Expert Report of Dr. Gregory K. Leonard, dated February 8, 2016, in ¶¶187-190.
[5] This is equal to **[b]** * **[f]** + **[d]** * **[g]**, values for **[b]** and **[d]** from 2009 - 2011 are assumed to be equal to 2012. This is for convenience, not as an endorsement of the validity of such an approach or assumption.

**Exhibit 4f**
**Application Counts in Dr. Leonard's and Kearl Counterfactual Scenarios**

| | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|
| (a) **Dr. Leonard's Counterfactual** | 751 | 762 | 1,125 | 1,175 | **2,687** |
| (b) **Kearl Scenario 1** | 751 | 761 | 1,124 | 1,175 | **2,686** |
| (c) **Kearl Scenario 2** | 525 | 581 | 822 | 854 | **1,814** |
| (d) **Kearl Scenario 3** | 177 | 202 | 170 | 127 | **344** |
| **Total in Sample** | 1,108 | 967 | 1,356 | 1,512 | **3,642** |

**Notes:**
[1] (a) Is Dr. Leonard's default counterfactual encompassing 2687 Apps.
[2] (b) Is Dr. Leonard's counterfactual excluding inclusion criteria: Dual-Language Companies only.
[3] (c) Is Dr. Leonard's counterfactual excluding inclusion criteria: Dual-Language Companies and Dual-Homing Companies.
[4] (d) Is Dr. Leonard's counterfactual excluding inclusion criteria: Dual-Language Companies, Dual-Homing Companies, and Dual-Homing.
[5] The sample of applications used by Dr. Leonard consists of 16177 observations of 3642 total applications.
[6] See Section 8.1.4.1 of the Expert Report of James R. Kearl, dated March 18, 2016 for clarification of the three Kearl Counterfactual Scenarios.

## Exhibit 4g (Corrected)

### Dr. Gregory K. Leonard's Exhibit 3d.1 Under Constant 13.55% Share Loss

### Revenue Loss Analysis from Jan. 2008 through Dec. 2015

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0 1 | $ 2 1 | $ 16 3 | $ 77 2 | $ 291 7 | $ 631 4 | $ 1257 9 | $ 1647 1 | $ 3,923 7 |
| Hardware | -- | -- | 15 6 | 0 0 | 41 1 | 113 1 | 45 7 | 52 8 | 268 3 |
| Apps | 0 0 | 0 1 | 1 1 | 4 9 | 18 4 | 194 5 | 380 8 | 480 4 | 1,080 2 |
| Digital Content | -- | -- | -- | 2 0 | 14 3 | 40 3 | 75 5 | 92 3 | 224 5 |
| **Total** | **$ 0.1** | **$ 2.3** | **$ 33.0** | **$ 84.1** | **$ 365.5** | **$ 979.3** | **$ 1,759.9** | **$ 2,272.6** | **$ 5,496.8** |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0 0 | $ 0 4 | $ 5 6 | $ 14 7 | $ 74 8 | $ 177 7 | $ 355 8 | $ 465 9 | $ 1,094 8 |
| Hardware | -- | -- | -- | 0 0 | 46 1 | 135 7 | 56 7 | 75 4 | 314 0 |
| Apps | -- | -- | -- | 0 0 | 8 4 | 115 8 | 142 1 | 121 9 | 388 3 |
| Digital Content | -- | -- | -- | 3 2 | 23 0 | 51 0 | 79 9 | 97 3 | 254 4 |
| Infrastructure & Other COS | -- | -- | -- | 9 2 | 12 9 | 16 7 | 39 6 | 59 5 | 137 8 |
| Operations | 0 0 | 0 1 | 0 6 | -- | -- | -- | -- | -- | 0 7 |
| COS (including DTC) | 0 0 | 0 0 | 14 9 | -- | -- | -- | -- | -- | 14 9 |
| **Total** | **$ 0.1** | **$ 0.5** | **$ 21.1** | **$ 27.0** | **$ 165.2** | **$ 496.9** | **$ 674.2** | **$ 820.1** | **$ 2,205.0** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0 0 | $ 1 8 | $ 11 9 | $ 57 0 | $ 200 4 | $ 482 3 | $ 1,085 7 | $ 1,452 6 | $ 3,291 8 |
| Gross Margin (%) | 41 4 % | 78 0 % | 36 1 % | 67 8 % | 54 8 % | 49 3 % | 61 7 % | 63 9 % | 59 9 % |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- |
| Android Marketing | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android Legal | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android Sales and Other | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android General and Administrative | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Incremental Search and Advertising Expenses | 0 0 | 0 2 | 1 3 | 6 4 | 24 1 | 52 2 | 103 9 | 136 1 | 324 1 |
| **Total** | **$ 0.0** | **$ 0.2** | **$ 1.3** | **$ 6.4** | **$ 24.1** | **$ 52.2** | **$ 103.9** | **$ 136.1** | **$ 324.1** |
| Android Advertising Share Loss | 13 55 % | 13 55 % | 13 55 % | 13 55 % | 13 55 % | 13 55 % | 13 55 % | 13 55 % | |
| Google Play Share Loss | 13 55 | 13 55 | 13 55 | 13 55 | 13 55 | 13 55 | 13 55 | 13 55 | |
| Diversion Ratio | 44 0 | 44 0 | 44 0 | 44 0 | 44 0 | 41 0 | 40 5 | 42 3 | |
| Search Share | 100 0 | 76 0 | 67 3 | 76 9 | 67 1 | 64 9 | 65 2 | 68 6 | |
| Gross Loss of Profit | $ 0 0 | $ 1 6 | $ 10 6 | $ 50 7 | $ 176 3 | $ 430 2 | $ 981 8 | $ 1,316 5 | $ 2,967 6 |
| iPhone Offset | (0 0) | (0 6) | (3 5) | (20 5) | (72 2) | (140 6) | (275 6) | (373 6) | (886 5) |
| **Net Loss of Profit** | **$ 0.0** | **$ 1.0** | **$ 7.1** | **$ 30.2** | **$ 104.1** | **$ 289.6** | **$ 706.2** | **$ 942.9** | **$ 2,081.1** |

**Sources:**

Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 3d.1.

Expert Report of Dr. Alan J. Cox, Revised April 15, 2012, pp. 41 and 58.

## Exhibit 4h (Corrected)

**Dr. Gregory K. Leonard's Exhibit 3d.1 Under Constant 20.7% Share Loss**

**Revenue Loss Analysis from Jan. 2008 through Dec. 2015**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| *(in millions)* | | | | | | | | | |
| **Revenue (Share Loss)** | | | | | | | | | |
| Ads | $ 0 1 | $ 3 3 | $ 24 9 | $ 117 9 | $ 445 5 | $ 964 5 | $ 1921 7 | $ 2516 3 | $ 5,994 1 |
| Hardware | -- | -- | 23 8 | 0 0 | 62 8 | 172 8 | 69 8 | 80 7 | 409 9 |
| Apps | 0 0 | 0 2 | 1 7 | 7 5 | 28 2 | 297 1 | 581 7 | 733 8 | 1,650 3 |
| Digital Content | -- | -- | -- | 3 1 | 21 9 | 61 6 | 115 3 | 141 1 | 342 9 |
| **Total** | **$ 0.1** | **$ 3.5** | **$ 50.4** | **$ 128.4** | **$ 558.4** | **$ 1,496.0** | **$ 2,688.5** | **$ 3,471.8** | **$ 8,397.3** |
| **Cost of Sales (Share Loss)** | | | | | | | | | |
| TAC | $ 0 0 | $ 0 6 | $ 8 5 | $ 22 4 | $ 114 2 | $ 271 4 | $ 543 5 | $ 711 7 | $ 1,672 5 |
| Hardware | -- | -- | -- | 0 0 | 70 5 | 207 4 | 86 6 | 115 3 | 479 7 |
| Apps | -- | -- | -- | 0 0 | 12 9 | 177 0 | 217 1 | 186 3 | 593 3 |
| Digital Content | -- | -- | -- | 4 9 | 35 1 | 77 9 | 122 1 | 148 7 | 388 6 |
| Infrastructure & Other COS | -- | -- | -- | 14 1 | 19 7 | 25 5 | 60 5 | 90 9 | 210 6 |
| Operations | 0 0 | 0 1 | 0 9 | -- | -- | -- | -- | -- | 1 0 |
| COS (including DTC) | 0 0 | 0 1 | 22 7 | -- | -- | -- | -- | -- | 22 8 |
| **Total** | **$ 0.1** | **$ 0.8** | **$ 32.2** | **$ 41.3** | **$ 252.3** | **$ 759.2** | **$ 1,029.9** | **$ 1,252.8** | **$ 3,368.5** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $ 0 1 | $ 2 7 | $ 18 2 | $ 87 1 | $ 306 1 | $ 736 9 | $ 1,658 6 | $ 2,219 1 | $ 5,028 8 |
| Gross Margin (%) | 41 4 % | 78 0 % | 36 1 % | 67 8 % | 54 8 % | 49 3 % | 61 7 % | 63 9 % | 59 9 % |
| **Operating Expenses (Share Loss)** | | | | | | | | | |
| Android Engineering PM | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- | $ -- |
| Android Marketing | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android Legal | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android Sales and Other | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Android General and Administrative | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Incremental Search and Advertising Expenses | 0 0 | 0 3 | 2 1 | 9 7 | 36 8 | 79 7 | 158 8 | 207 9 | 495 2 |
| **Total** | **$ 0.0** | **$ 0.3** | **$ 2.1** | **$ 9.7** | **$ 36.8** | **$ 79.7** | **$ 158.8** | **$ 207.9** | **$ 495.2** |
| Android Advertising Share Loss | 20 7 % | 20 7 % | 20 7 % | 20 7 % | 20 7 % | 20 7 % | 20 7 % | 20 7 % | |
| Google Play Share Loss | 20 7 | 20 7 | 20 7 | 20 7 | 20 7 | 20 7 | 20 7 | 20 7 | |
| Diversion Ratio | 44 0 | 44 0 | 44 0 | 44 0 | 44 0 | 41 0 | 40 5 | 42 3 | |
| Search Share | 100 0 | 76 0 | 67 3 | 76 9 | 67 1 | 64 9 | 65 2 | 68 6 | |
| Gross Loss of Profit | $ 0 0 | $ 2 4 | $ 16 1 | $ 77 4 | $ 269 3 | $ 657 2 | $ 1,499 9 | $ 2,011 2 | $ 4,533 6 |
| iPhone Offset | (0 0) | (0 9) | (5 3) | (31 3) | (110 2) | (214 8) | (421 0) | (570 8) | (1354 4) |
| **Net Loss of Profit** | **$ 0.0** | **$ 1.6** | **$ 10.8** | **$ 46.1** | **$ 159.1** | **$ 442.4** | **$ 1,078.8** | **$ 1,440.4** | **$ 3,179.2** |

**Sources:**

Expert Report of Dr. Gregory K. Leonard dated February 8, 2016 Exhibit 3d.1.

Exhibit 4a.2, Percent Change in Android Handset Sales under Scenario 3.

**Exhibit 5a. Android-Related Profits with iPhone Recapture Adjustment**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Revenue** | | | | | | | | | |
| Ads | $0.7 | $15.7 | $120.1 | $569.4 | $2,152.4 | | | | $28,957.1 |
| Hardware | $0.0 | $0.0 | $115.2 | $0.0 | $303.5 | | | | $1,980.4 |
| Apps | $0.0 | $1.1 | $8.0 | $36.2 | $136.1 | | | | $7,972.2 |
| Digital Content | -- | -- | -- | $14.8 | $105.8 | | | | $1,656.7 |
| **Total** | **$0.7** | **$16.8** | **$243.3** | **$620.4** | **$2,697.8** | | | | **$40,566.5** |
| **Cost of Sales** | | | | | | | | | |
| TAC | $0.2 | $2.9 | $41.3 | $108.3 | $551.7 | | | | $8,079.6 |
| Hardware | -- | -- | -- | -$0.2 | $340.6 | | | | $2,317.5 |
| Apps | -- | -- | -- | $0.0 | $62.2 | | | | $2,866.0 |
| Digital Content | -- | -- | -- | $23.5 | $169.5 | | | | $1,877.4 |
| Infrastructure & Other COS | -- | -- | -- | $67.9 | $95.0 | | | | $1,017.3 |
| Operations | $0.2 | $0.5 | $4.3 | -- | -- | | | | $5.0 |
| COS (including DTC) | $0.0 | $0.3 | $109.9 | -- | -- | | | | $110.2 |
| **Total** | **$0.4** | **$3.7** | **$155.5** | **$199.5** | **$1,219.0** | | | | **$16,273.0** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $0.3 | $13.1 | $87.9 | $420.9 | $1,478.8 | | | | $24,293.5 |
| Gross Margin (%) | 41.4% | 78.0% | 36.1% | 67.8% | 54.8% | | | | 59.9% |
| **Operating Expenses** | | | | | | | | | |
| Android Engineering PM | $86.3 | $43.1 | $107.7 | $192.3 | $380.4 | | | | $2,643.5 |
| Android Marketing | $12.3 | $16.6 | $53.3 | $53.9 | $225.3 | | | | $2,239.1 |
| Android Legal | $1.0 | $2.1 | $32.2 | $160.5 | $113.7 | | | | $889.3 |
| Android Sales and Other | $0.9 | $3.2 | $5.2 | $16.3 | $37.3 | | | | $412.7 |
| Android General and Administrative | -- | $26.8 | $42.8 | $126.0 | $124.7 | | | | $1,499.4 |
| Incremental Search and Advertising Expenses | $0.1 | $1.3 | $9.9 | $47.0 | $177.8 | | | | $2,392.1 |
| **Total** | **$100.6** | **$93.1** | **$251.1** | **$596.1** | **$1,059.2** | | | | **$10,076.2** |
| **Profit Before iPhone Recapture Adjustment** | | | | | | | | | |
| Total Operating Profit | -$100.3 | -$80.0 | -$163.2 | -$175.2 | $419.6 | | | | $14,217.3 |
| **iPhone Recapture Adjustment** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | | | | [redacted] |
| **Profit** | [redacted] | [redacted] | [redacted] | [redacted] | [redacted] | | | | [redacted] |

**Source:**

[1] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1a.3

**Exhibit 5b. iPhone Recapture Adjustment**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Revenue** | | | | | | | | | |
| Ads | $0.7 | $15.7 | $120.1 | $569.4 | $2,152.4 | | | | $28,957.1 |
| Hardware | -- | -- | -- | -- | -- | | | | -- |
| Apps | -- | -- | -- | -- | -- | | | | -- |
| Digital Content | -- | -- | -- | -- | -- | | | | -- |
| **Total** | **$0.7** | **$15.7** | **$120.1** | **$569.4** | **$2,152.4** | | | | **$28,957.1** |
| **Cost of Sales** | | | | | | | | | |
| TAC | $0.2 | $2.9 | $41.3 | $108.3 | $551.7 | | | | $8,079.6 |
| Hardware | -- | -- | -- | -- | -- | | | | -- |
| Apps | -- | -- | -- | -- | -- | | | | -- |
| Digital Content | -- | -- | -- | -- | -- | | | | -- |
| Infrastructure & Other COS | -- | -- | -- | -- | -- | | | | -- |
| Operations | -- | -- | -- | -- | -- | | | | -- |
| COS (including DTC) | -- | -- | -- | -- | -- | | | | -- |
| **Total** | **$0.2** | **$2.9** | **$41.3** | **$108.3** | **$551.7** | | | | **$8,079.6** |
| **Gross Profit** | | | | | | | | | |
| Total Gross Profit | $0.5 | $12.8 | $78.9 | $461.1 | $1,600.7 | | | | $20,877.5 |
| Gross Margin (%) | 70.6% | 81.7% | 65.7% | 81.0% | 74.4% | | | | 72.1% |
| **Operating Expenses** | | | | | | | | | |
| Android Engineering PM | -- | -- | -- | -- | -- | | | | -- |
| Android Marketing | -- | -- | -- | -- | -- | | | | -- |
| Android Legal | -- | -- | -- | -- | -- | | | | -- |
| Android Sales and Other | -- | -- | -- | -- | -- | | | | -- |
| Android General and Administrative | -- | -- | -- | -- | -- | | | | -- |
| Incremental Search and Advertising Expenses | $0.1 | $1.3 | $9.9 | $47.0 | $177.8 | | | | $2,392.1 |
| **Total** | **$0.1** | **$1.3** | **$9.9** | **$47.0** | **$177.8** | | | | **$2,392.1** |
| Diversion Ratio | 44.0% | 44.0% | 44.0% | 44.0% | 44.0% | 41.0% | 40.5% | 42.3% | |
| Search Share | 100.0% | 76.0% | 67.3% | 76.9% | 67.1% | | | | |
| **iPhone Recapture Adjustment** | | | | | | | | | |

**Source:**

[1] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibit 1b

**Exhibit 6. Java ME Lost Profits**

| | | | FY2009 | FY2010 | FY2011 | FY2012 | FY2013 | FY2014 | FY2015 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| [1] | | **Total Java ME Licensing Revenue** | $96,951,229 | $100,657,682 | $123,610,000 | $150,198,000 | $86,754,824 | [redacted] | [redacted] | $608,568,092 |
| [2] | | Total Handset Units | 1,276,577,524 | 1,455,988,268 | 1,653,544,456 | 1,719,591,082 | 1,799,024,686 | 1,885,107,543 | 1,962,186,444 | 11,752,020,003 |
| [3] | | Android Units | 1,923,643 | 18,313,597 | 129,103,093 | 335,969,248 | 633,443,871 | 912,391,740 | 1,104,512,243 | 3,135,657,435 |
| [4] | [2] - [3] | *Non-Android Handsets* | 1,274,653,881 | 1,437,674,671 | 1,524,441,362 | 1,383,621,834 | 1,165,580,815 | 972,715,803 | 857,674,201 | 8,616,362,568 |
| [5] | | iPhone Units | 18,784,872 | 32,188,110 | 65,400,237 | 113,372,547 | 141,184,951 | 162,843,234 | 218,333,678 | 752,107,628 |
| [6] | [4] - [5] | *Potential Java ME Licensed Handsets* | 1,255,869,009 | 1,405,486,561 | 1,459,041,125 | 1,270,249,287 | 1,024,395,865 | 809,872,569 | 639,340,523 | 7,864,254,939 |
| [7] | [1] / [6] | **Java ME Licensing Revenue per Potential Java ME Licensed Handset (FY2009)** | $0.08 | $0.08 | $0.08 | $0.08 | $0.08 | $0.08 | $0.08 | |
| [8] | | [1 - Ad Revenue Diversion Ratio (Android to iOS)] | 56.0% | 56.0% | 56.0% | 56.0% | 59.0% | 59.5% | 57.7% | |
| [9] | [3] * [8] | **Android Handsets That Would Be Potential Java ME Licensed Handsets** | 1,076,740 | 10,250,850 | 72,264,148 | 188,055,381 | 373,901,089 | 543,308,662 | 637,830,859 | 1,826,687,728 |
| [10] | [7] * [9] | **Potential Java ME Licensing Revenue from Android Handsets** | $83,123 | $791,350 | $5,578,685 | $14,517,597 | $28,864,611 | [redacted] | [redacted] | $141,017,589 |
| [11] | | Incremental Expense as a % of Lost Revenue | 17.6% | 17.6% | 10.0% | 9.8% | 9.5% | [redacted] | [redacted] | 13.9% |
| [12] | [10] * [11] | *Incremental Expenses* | $14,615 | $139,142 | $558,797 | $1,423,091 | $2,743,161 | [redacted] | [redacted] | $19,536,934 |
| [13] | [10] - [12] | **Java ME Lost Profits** | $68,507 | $652,208 | $5,019,888 | $13,094,506 | $26,121,449 | [redacted] | [redacted] | $121,480,655 |
| [14] | | **Sun / Oracle Weighted Average Cost of Capital (WACC)** | 12.7% | 9.1% | 9.6% | 10.7% | 10.0% | 9.8% | 8.9% | |
| [15] | | **2008 Certainty Equivalent of Java ME Lost Profits** | $60,806 | $530,486 | $3,723,926 | $8,772,269 | $15,904,024 | [redacted] | [redacted] | $69,541,463 |
| [16] | | **Present Value of Java ME Lost Profits as of Oracle FY2015's Ending** | | | | | | | | $87,049,978 |

**Sources:**
Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 3d.2, 4f, 4e
Board of Governors of the Federal Reserve System, http //www.federalreserve.gov/releases/h15/data.htm, accessed March 16, 201€
Bloomberg

**Notes:**
[a] Actual Java ME Licensing Revenue data reflect Oracle's fiscal years ending on May 31.
[b] Volume figures are adjusted to reflect Oracle's fiscal years ending on May 31.
[c] WACCs reported above are as follows for FY2009, Sun Microsystems; for FY2010-FY2015, Oracle. All WACCs were obtained from Bloomberg
[d] Present Value of Java ME Lost Profits is calculated using the 2009 Federal Reserve Board Nominal 10-year US Treasury Bill Rate of 3.26%

**Exhibit 7. Comparison of Mr. Malackowski's and Dr. Leonard's Apportionment Approaches**
***(in millions)***

| | Malackowski | Leonard | Difference (L - M) | |
|---|---|---|---|---|
| | Total | Total | ($) | (%) |
| **Android Ad Revenue** | | | | |
| *Search* | | | $0.0 | 0% |
| *AdSense/AFS* | | | -$2,051.0 | -100% |
| *Display* | | | -$7,512.5 | -100% |
| **Total** | | | -$9,563.5 | -33% |
| **Android Ad TAC** | | | -$6,330.4 | -100% |
| **Android Ad Revenue - Ad TAC** | | | -$3,233.1 | -14% |
| **Apportionment Factor** | | | -3.8% | -11% |
| **Apportioned Android Ad Profit** | | | -$1,883.0 | -23% |
| **Other Android Revenue** | | | | |
| *Applications* | | | $0.0 | 0% |
| *Digital Content* | | | $0.0 | 0% |
| *Hardware* | | | $0.0 | 0% |
| **Total Other Android Revenue** | | | $0.0 | 0% |
| **Total Android Revenue (with Apportionment)** | | | -$1,882.9 | -10% |
| **Android Cost of Sales** | | | | |
| *Applications* | | | $0.0 | 0% |
| *Digital Content* | | | $0.0 | 0% |
| *Hardware* | | | -$109.9 | -5% |
| *Infrastructure & Other COS* | | | -$5.3 | -1% |
| *Operations* | | | $5.0 | - |
| *COS (Including DTC)* | | | $110.2 | - |
| **Total Android Cost of Sales (Excluding TAC)** | | | $0.0 | 0% |
| **Gross Profit of Other Android Revenue** | | | $0.0 | 0% |
| **Android Operating Expenses** | | | | |
| *Android Engineering PM* | | | $2,643.5 | - |
| *Android Marketing* | | | -$0.1 | 0% |
| *Angroid Legal* | | | $889.3 | - |
| *Android Sales and Other* | | | $0.0 | 0% |
| *Android General and Administrative* | | | $1,499.4 | - |
| *Incremental Search and Advertising Expenses* | | | $0.0 | - |
| **Total Android Operating Expenses** | | | $5,032.2 | 190% |
| **Total Android Profit** | | | -$6,915.1 | -78% |

**Sources:**

[1] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), paras. 273-305
[2] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Figure 12
[3] Responsive Expert Report of James E. Malackowski, February 29, 2016 (Corrected), Exhibits 7, 7.1, 7.6, 7.7, 8 and 8.1
[4] Expert Report of Dr. Gregory K. Leonard, Corrected March 10, 2016, paras. 63-64
[5] Expert Report of Dr. Gregory K. Leonard, February 8, 2016, Exhibits 1a.1, 1a.4 and 1c